Ingenious COCKER! (Now to Rest thou'rt G
Noe Art can Show thee fully but thine own
Thy rare Arithmetick alone can shon
Th' vast Sums of Thanks wee for thy Labo

Mosc Cocker.

Cockers ARITHMETICK,

Being

A plain and familiar Method ſuitable to the meaneſt capacity for the full underſtanding of that incomparable Art, as it is now taught by the ableſt School-Maſters in City and Countrey.

Compoſed

By *Edward Cocker*, late Practitioner in the Arts of Writing, Arithmetick, and Engraving. Being that ſo long ſince promiſed to the world.

Peruſed

And publiſhed by *John Hawkins* VVriting-Maſter near *St. Georges* Church in *Southwark*, by the Authors correct Copy, and commended to the World by many eminent Mathematicians and Writing-Maſters in and near *London*.

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The ſecond Impreſſion.

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1678
Office

TO his much honored Friends, *Manwering Davies* of the *Inner Temple* Esquire, And Mr. *Humphry Davies* of St. *Mary Newington* Butts in the County of *Surry*.

John Hawkins As an acknowledgement of unmerited favours, humbly Dedicateth this *Manuel of Arthmetick*.

To the READER.

Courteous Reader,

I Having the Happineſs of an Intimate Acquaintance with Mr. *Cocker* in his life time, often ſollicited him to remember his Promiſe to the world of Publiſhing his *Arithmetick*, but (for Reaſons beſt known to himſelf) he refuſed it, and (after his Death) the Copy falling accidentally into my hands, I thought it not convenient to ſmother a work of ſo conſiderable a moment, not queſtioning but it might be as kindly accepted as if it had been preſented by his own hand. The Method is Familiar and eaſie, diſcovering as well the Theorick as the Practick of that moſt Neceſſary *Art* of Vulgar *Arithmetick*: and thou mayſt ſpeedily expect his Decimal, Logarithmetical, and *Algebraical Arithmetick*, concerning which thou haſt a further account given at the end of this Book. In the mean time Judge favourably of the preſent undertaking, and thou wilt Oblige him, who is,

Thine to Serve thee,
John Hawkins.

From my School near St. *George's* Church in *Southwark*, *Nov.* 29. 1677.

Mr.

Mr. *Edward Cocker's*
PROEME or PREFACE.

BY the ſacred influence of Divine Providence, I have been inſtrumental to the benefit of many, by vertue of thoſe uſeful Arts, Writing *and* Engraving: *And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the publick Treaſury; beſeeching the Almighty to grant the like bleſſing to theſe, as to my former labours.*

Seven Sciences *ſupremely excellent*
Are the chief Stars in Wiſdom's Firmament:
Whereof Arithmetick *is one, whoſe worth*
In beams of Profit and Delight ſhines forth.
This crowns the reſt: this makes man's mind compleat;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this Subject; who in a pleaſing freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their expectations, I know not; but this I know, that I have deſign'd this Work not extraordinary abſtruſe or profound, but

have by all means poſſible, within the circumference of my capacity, endeavoured to render it extraordinary uſeful to all thoſe whoſe occaſions ſhall induce them to make uſe of Numbers. If it be objected that the Books already publiſhed, treating of Numbers, are innumerable; I anſwer, that's but a ſmall wonder, ſince the Art is infinite. But that there ſhould be ſo many excellent Tracts of Practical Arithmetick extant, and ſo little practic'd, is to me a greater wonder: knowing that as Merchandize is the Life of the Weal-publick; ſo Practical Arithmetick is the Soul of Merchandize. Therefore I do ingenuouſly profeſs, that in the beginning of this undertaking, the numerous concerns of the honoured Merchants firſt poſſeſt my conſideration: and how far I have accommodated this Compoſure for his moſt worthy ſervice, let his own profitable experience be judge.

Secondly, For your ſervice, moſt excellent Profeſſors, whoſe underſtandings ſoar to the ſublimity of the Theory and Practice of this noble Science, was this Arithmetical Tractate compos'd: which you may pleaſe to employ as a monitor to inſtruct your young Tyroes, *and thereby take occaſion to reſerve your precious moments, which*

which might be exhauſted that way, for your more important affairs.

Thirdly, For you, the ingenious Off-ſpring of happy Parents, who will willingly pay the full price of Induſtry and Exerciſe for thoſe Arts and choice accompliſhments which may contribute to the felicity of your future ſtate. For you, I ſay (ingenious Practitioners) was this Work compoſed, which may prove the pleaſure of your youth, and the glory of your age.

Laſtly, for you the pretended Numeriſts of this vapouring age, who are more diſingenuouſly witty to propound unneceſſary queſtions, than ingeniouſly judicious to reſolve ſuch as are neceſſary. For you was this Book compoſed and publiſhed, if you will deny your ſelves ſo much as to invert the ſtreams of your ingenuity, and by ſtudiouſly conferring with the Notes, Names, Orders, Progreſs, Species, Properties, Proprieties, Proportions, Powers, Affections and Applications of Numbers delivered herein, become ſuch Artiſts indeed, as you now only ſeem to be. This Arithmetick ingeniouſly obſerved, and diligently practiſed, will turn to good account to all that ſhall be concerned in Accompts. All whoſe Rules are grounded on Verity, and deliver'd with Sincerity. The examples are built up gradually

dually from the ſmalleſt conſideration to the greateſt. All the Problemes or Propoſitions are well weigh'd, pertinent and clear, and not one of them throughout the Tract taken upon truſt; therefore now,

Zoilus and *Momus* lye you down and dye,
For theſe inventions your whole force defy

Edward Cocker.

Courteo

ourteous Reader,

Being well acquainted with the deceased Author, and finding him knowing and studious in the Misteries of Numbers and Algebra, of which he had some choice Manuscripts, and a great Collection of Printed Authors in several Languages. I doubt not but he hath writ his Arithmetick suitable to his own Preface, and worthy acceptation, which I thought to certifie on a request to that purpose made to him that wisheth thy welfare, and the progress of Arts.

John Collins.

Novemb. 27th. 1677.

his Manual of Arithmetick is recommended to the World by us whose names are subscribed, *viz.*

Mr. *John Collins*
Mr. *James Atkinson* } Math.
Mr. *Peter Perkins*
Mr. *Rich. Noble* of *Guilford*
Mr. *Rich. Laurence*, Senior
Mr. *Eleazar Wigan.*
Mr. *Benj. Williams.*
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Mr. *Joseph Symmonds*
Mr. *Jerem. Milles*
Mr. *Josiah Cuffley*
Mr. *John Hawkins.*

A Ta-

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CHAP. I.

Notation of Numbers.

I. ARITHMETICK is an Art of Numbring, or Knowledge which teacheth to Number well; (*viz.*) the Doctrine of Accompting by Numbers. And there are divers ſpecies and kinds of Arithmetick and Geometry, the which we do intend to treat of in order, applying the Principles of the one, to the Definitions of the other: For as Magnitude or Greatneſs is the ſubject of Geometry, ſo Multitude or Number, is the ſubject of Arithmetick; and if ſo, then their firſt Principles and chief Fundamentals, muſt have like Definitions; or at leaſt, a Semblable Congruency.

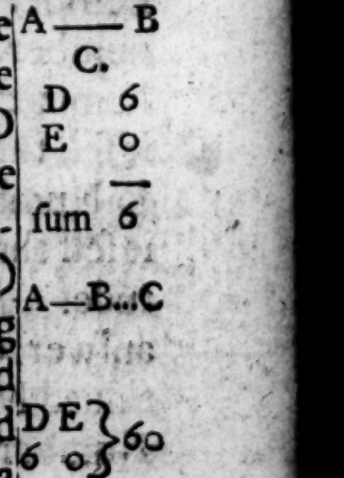
II. Number, is that by which the Quantity of any thing is Expreſſed or Numbred; as the Unit is a number by which the quantity of one thing is expreſſed or ſaid to be

one, and two by which it is named two, and ½ half by which it is named or called half, and the Root of 3 by which it is called the Root of 3, the like of any other.

3. Hence it is that Unit is Number, for the part is of the ſame matter that is his whole, the Unit is part of the Multitude of Units, therefore the Unit is of the ſame matter that is the Multitude of Units; but the matter of the multitude of Units is number, therefore the matter of Unit is number: for elſe if from a number given no number be ſubſtracted, the number given remaineth; let three be the number given, from which number ſubſtract, or take away one (which as ſome conceive is no number) therefore the number given remaineth, that is to ſay, there remaineth three, which is abſurd.

4. Hence it will be convenient to examine from whence number hath its Riſe or Beginning; Moſt Authors maintain that Unit is the beginning of number, and it ſelf no number; but looking upon the Principles and Definitions in the firſt rudiments of Geometry, we ſhall find, that the definition of a point is in no way congruous with the definition of an Unit in Arithmetick; and therefore one, or unit muſt be in the bounds or limits of Number, and conſequently

ſequently the beginning of number is not to be found in the number one; wherefore to make number and magnitude congruent in Principles, and like in Definitions, we make and conſtitute a Cypher to be the beginning of number, or rather the medium between Increaſing and Decreaſing numbers, commonly called abſolute or whole numbers, and negative or fractional numbers, between which, nothing can be Imagined more agreeable to the definition of a point in Geometry; for as a point is an adjunct of a line and it ſelf no line, ſo is (o) Cypher an adjunct of number and it ſelf no number: And as a point in Geometry cannot be divided or increaſed into partes, ſo likewiſe (o) cannot be divided or increaſed into parts; for as many points though in number infinite do make no line, ſo many (o) Cyphers, thongh in number infinite do make no number. For the line A B cannot be Increaſed by the addition of the point. C, neither can the number D be increaſed by the addition of the (o) Cypher E, for if you add nothing to 6, the ſum will be 6, (o) neither increaſing nor diminiſhing the number 6, but if it be granted that A B be extended or prolonged to the point C, ſo that A C be made a



cont nued line, then A B is increaſed by the addition of the point C, In like manner if we grant D 6 be prolonged to E (o) ſo that D E (60) be a cont nued number making 60, then 6 is Augmented by the Aid of (o) as to the conſtituting the number (60) ſixty, And furthermore that one or unit is material and a number, and that (o) is the beginning of number, is proved by all Authors although indirectly, for the Tables of Sines and Tangents prove one degree to be a number, becauſe the Sine of 1 degree is 174524 (the Radius being 10000000) and the beginning of that Table is (o) and to it Anſwereth 00000 *&c.*

5. Hence it is that number is not quantity diſcontinued, for all that which is but one quantity, is not quantity disjunct; (60) ſixty as it is a number, is one quantity, *viz.* one number: *(60)* ſixty therefore as it is number, it is not quantity disjunct; for number is ſome ſuch thing in magnitude, as humidity in water; for as humidity extends it ſelf through all and every part of Water, ſo Number alated to magnitude, doth extend it ſelf through all and every part of magnitude. Alſo as to continued Water doth anſwer continued Humidity, ſo to a continued Magnitude doth anſwer a continued Number. As the continued Humidity of

any

any intire Water, ſuffereth the ſame Diviſion and Diſtinction that his Water doth; ſo the continued Number ſuffereth the ſame Diviſion and Diſtinction that his Magnitude doth. From all which conſiderations we might enlarge a farther digreſſion concerning Number and Magnitude, by comparing the Definitions of the one, with the Principles of the other, for having found a (o) Cypher to be anſwerable in Definition to a point in Magnitude, we may very well conclude that number may be congruent to a line; as alſo the Figurative number to be conſonant in definition with a ſuperficies, and ſolid, *&c.* in the order of Geometrical Magnitudes.

6. The Characters or Notes by which Numbers are ſignified, or by which a Number is ordinarily expreſſed, are theſe following, (*viz*) 0 Cypher or nothing, 1 One, 2 Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, 8 Eight, 9 Nine; The Cypher which though of it ſelf ſignifieth nothing, (*viz.*) expreſſeth not any certain, or known quantity, but is the beginning, Radix or Root of Number, and the other nine Figures or Characters are called ſignificant Figures or Digits.

7. In Numbers of any ſort, two things

are to be conſidered, (*viz.*) Notation and Numeration.

8. Notation teacheth how to deſcribe any Number by certain Notes and Characters, and to declare the value thereof being ſo deſcribed, and that is by Degrees and Periods.

9. A degree conſiſts of three figures, (*viz.*) of three places comprehending Units Tens and Hundreds, ſo 365 is a degree, and the firſt figure (5) on the right hand, ſtands ſimply for its own value, being Units or ſo many ones (*viz.*) five; the ſecond in order from the right, ſignifies as many times ten, as there are units contained in it, (*viz.*) ſixty; the third in the ſame order ſignifies ſo may hundreds as it contains units ſo will the expreſſion of the Number be, three hundred ſixty five, alſo 789, is ſeven hundred eighty nine, *&c.*

10. A period is when a Number conſiſts of more than three figures, or places, and whoſe proper order is to prick or diſtinguiſh every third place, beginning at the right hand, and ſo on to the leſt; ſo the Number 63452 being given it will be diſtinguiſhed thus, 63.452 and expreſſed thus ſixty three thouſand four hundred fifty two, likewiſe 4.578.236.782 being diſtinguiſhed as you ſee will be expreſſed thus, four thou-

thouſand five hundred ſeventy eight millions, two hundred thirty ſix thouſand, ſeven hundred eighty two.

11. Number is either Abſolute or Negative.

12. An Abſolute, or Intire, whole, Increaſing Number, is that which by annexing of another figure or cypher it becomes ten times as much as it ſtood for before; and if two figures or cyphers be annexed, it makes it a hundred times more than it ſtood for before, *&c.* as if you annex to the figure 6 a Cypher, then it will become (60) ſixty: ſo if two Cyphers be annexed, then it will be (600) ſix hundred; and if you do annex to it a (4) four, then it will be (64) ſixty four; and if you annex (78) ſeventy eight, it will be then (678) ſix hundred ſeventy eight, and ſo on: By annexing more figures or cyphers, it will increaſe in a decuple proportion *ad Infinitum.*

13. A Negative, or Broken, Fractional, Decreaſing Number, is that which by prefixing a point or prick towards the left hand its value is decreaſed from ſo many units, to ſo many tenth parts of any thing; and if a point and (0) cypher, or a digit be prefixed, it will be then ſo many hundred parts, and if a point, and two Cyphers, or digits be prefixed, its value is decreaſed to be ſo

many thousandth parts; as if you would prefix before the figure 3 a point (.) or prick thus (,3) it is then decreased from 3 Units or Integers, to (3) three tenth parts of a Unit or Integer; and if you prefix a point and cypher thus (.03) it is decreased from 3 Integers to 3 hundredth parts of an Integer, and by this means 5 l. Absolute by prefixing of a point will be decreased to 5 l. Negative which is 5 tenth parts of a pound, equal in value to ten shillings; And so by prefixing of more Cyphers or Digits, its value is decreased in a decuple proportion *ad infinitum.* As in the following Scheme or rather order of Numbers, we have placed (0) Cypher in its due place and order, as it is both the beginning and medium of Number; for going from (0) towards the left hand you deal with Intire, Absolute, Whole, Increasing Numbers.

Increasing Numbers.					*Decreasing Numbers*			
29	876	543	256	2 1 0 1 2	345	678	976	3
mm	mmm	mmm	mmm	CX U XC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	CX	CX				XC	mmm	m
X							XC	

But going from (0) the place of Units towards the Right hand, you meet with broken, Negative, Fractional and Decreasing Num-

Numbers. And hence it follows that Multiplication increaseth the product in Absolute Numbers, but decreaseth the product in Negative Numbers; Also Division decreaseth the quotient in whole Numbers, and increaseth it in Negative, or Fractional Numbers.

14. An Absolute, Intire, whole, Increasing *number*, hath always a point annexed towards the right hand and therefore

15. A Negative, Broken, Decimal, decreasing *number*, hath alwayes a point prefixed before it towards the left hand. When we express Integers, or whole *number*, *as* 5 *pounds*, 5 *feet*, 26 *men*, we usually annex a point or prick after the number, thus 5. 5. 26. 347. But when we express Decimals, or Numbers that are denyed to be Intire, as decreasing *numbers*, we do commonly prefix a point or prick before the said decimal, or decreasing *number*, thus (.3) that is 3 tenths, or 3 primes, .03, that is 3 hundredths or 3 seconds.

l. feet. men. Inch.

16. A whole or absolute *number* is an unit or a Composed multitude of units, and it is either a prime or else a compounded *number*.

17. Prime *numbers* amongst themselves are those which have no multitude of units

for a common measurer as 8 and 7 or 10 and 13 because not any multitude of units can equally measure or divide them without a Remainder.

18. Compound *numbers* amongst themselves are those which have a multitude of units for a common measurer, as 9 and 12 because 3 measures them exactly and abbreviates them to 3 and 4.

19. A Broken *number* commonly called a fraction, is a part or parts of a whole *number*; *viz.* a part of an Integer, as $\frac{1}{3}$ one third, is one third part of an unit.

20. A broken *number*, or fraction, consists of 2 parts, *viz.* the Numerator and the Denominator.

21. The Numerator and Denominator of a fraction, are set one over the other, with a line between them; and the Numerator is set above the line, and expresseth the parts therein contained.

22. The Denominator of a fraction is the Inferiour *number* placed below the line, and expresseth the number of parts into which the unit or Integer is divided; as let $\frac{3}{4}$ be the fraction given, so shall 3 be the numerator, and doth expresse or *number* the multitude of parts contained in this fraction, for $\frac{3}{4}$ is a fraction composed of fourths, or quarters, and the figure 3 in *numbering* shewes

ſhewes us that in that fraction there are 3 of thoſe fourth parts or quarters; alſo in the ſame fraction $\frac{3}{4}$, 4 is the *denominator* and doth expreſſe the Quality of the fraction, *viz.* that the whole, or integer, is here divided into 4 equal parts.

23. A broken *number* is either Proper or Improper; *viz.* Proper, when the *numerator* is leſſer than the *denominator*; ſo $\frac{3}{4}$ is a perfect proper fraction: But an Improper fraction hath its *numerator* greater, or at leaſt equal to the *denominator*; thus, $\frac{13}{8}$ is an Improper fraction: the Reaſon is given in the definition.

24. A proper broken *number*, is either *Simple*, or *Compound*; viz. *Simple*, when it hath one *Denomination*, and *Compound* when it conſiſteth of diverſe *Denominations*. If $\frac{3}{4}$ l. $\frac{6}{12}$ l. $\frac{25}{100}$ l. were given, we ſay they are either of them ſingle, or *ſimple* fractions becauſe they conſiſt but of one *numerator* and one *denominator*; but if $\frac{3}{4}$ of $\frac{6}{12}$ of $\frac{25}{100}$ of a pound ſterling were given, we ſay that it is a *compound broken number*, or *fraction*, becauſe the expreſſion and repreſentation, conſiſteth of more *denominations* than one; and ſuch by ſome are called *fractions of fractions*; and they have alwayes this particle (of) between them.

25. When a ſingle *broken number* or *fraction*, hath for his *denominator* a *number* conſiſting of a Unit in the firſt place towards the left hand, and nothing but Cyphers from the Unit towards the right hand, it is then the more aptly and rightly called a decimal fraction; under this head are all our decreaſing *numbers* placed, and in our 13th *definition* called Negative, and by that order there preſcribed we order them to be *Decimals*, by ſigning a point or prick before them, or the *numerator* rejecting the *denominator*: Therefore according to our laſt Rule, $\frac{5}{10}$ $\frac{5}{100}$ $\frac{25}{100}$ $\frac{25}{1000}$ are ſaid to be *Decimals*; and a *Decimal fraction* may be expreſſed without its *denominator* (as before) by prefixing a point or prick before the *numerator* of the ſaid *fraction*, and then ſhall the former *fraction* $\frac{5}{10}$ and $\frac{25}{100}$ ſtand thus .5 and .25.

But oftentimes as in the ſecond and 4th fractions $\frac{5}{100}$ and $\frac{25}{1000}$ a prick or point will not do without the help of a cypher or cyphers prefixed before the ſignificant figures of the *numerator*, and therefore when the *numerator* of a *decimal fraction*, conſiſteth not of ſo many places, as the *denominator* hath cyphers, fill up the void places of the *numerator* with prefixing Cyphers before the ſignificant figures of the *numerator*, and then

then ſign it for a *decimal*, ſo ſhall $\frac{5}{10}$ be ,05 and $\frac{25}{100}$ will be .025 and $\frac{72}{10000}$ will be .0072. Now by this we may eaſily diſcover the *denominator* having the *numerator*; for alwayes the denominator of any *decimal fraction*, conſiſts of ſo many Cyphers as the *numerator* hath places, with a unit prefixed before the ſaid Cyphers, *viz.* under the point or prick.

26. A *Decimal number* or *fraction*, is that which is expreſſed by *Primes, Seconds, Thirds, Fourths*, &c. and is *Number* decreaſing. Here inſtead of *Natural* and *Common fractions*, as $\frac{3}{4}$ of a thing, we order the thing or Integer into *Primes, Seconds, Thirds, Fourths, Fifths*, &c. that our expreſſion may be conſonant to our former order.

27. In *Decimal* Arithmetick, we alwayes imagin (and it would be very commodious if it were really ſo) that all intire units, Integers, and things are divided firſt into ten equal parts, and theſe parts ſo divided we call *Primes*; and ſecondly, we divide alſo each of the former *primes* into other ten equal parts, and every of theſe diviſions we call ſeconds; and thirdly, we divide each of the ſaid *ſeconds* into ten other equal parts, and thoſe ſo divided we call *Thirds*, and ſo by decimating the former and ſub-deci-

mating

mating theſe latter, we run on *ad infinitum.*

28. Let a pound ſterling, Troy weight, Averdupois weight, Liquid meaſure, Dry meaſure, Long meaſure, time, dozen or any other thing, or Integer be given to be *decimally* divided; in this notion premiſed, we ought to let the firſt diviſion be *Primes*, the next diviſion *Seconds*, the next *Thirds*, &c. So one pound ſterling being 20 ſhillings, which divided into ten equal parts the value of each part will be two ſhillings; therefore one *Prime* of a pound ſterling will ſtand thus (.1) which is in value 2 ſhillings: Three *Primes* will ſtand thus (.3) and that is in value 6 ſhillings. Again, a *Prime* or .1 being divided into ten equal parts, each of thoſe parts will be one *Second*, and is thus expreſſed, (.01) and its value will be found to be 2 d. farthing and $\frac{6}{10}$ of a farthing; and ſo will .05 ſignifie one ſhilling or five *Seconds*. And if .01 be divided into ten other equal parts, each of thoſe parts ſo divided will be *Thirds*, and will ſtand thus .001, and its value will be found to be .96 of a farthing, or $\frac{96}{100}$ of a farthing; and .009 *Thirds* will be 2d. and .64 of a farthing, or $\frac{64}{100}$ of a farthing, *&c.* So that .375 l. will be found to Repreſent 7 s. and 6 d.; for the 3 *Primes* are 6 ſhillings,

lings, and the 7 *Seconds* are 1 s. 4 d. and $\frac{8}{10}$ of a peny, and the five *Thirds* are 1 peny and $\frac{2}{10}$ of a peny, both which added together make 7 s. 6 d.

29. If you put any bulk, or body, repreſenting an Integer; if it be *decimally* divided, then the parts in the firſt decimation are *Primes*, the next *Seconds*, and the next decimation is *Thirds*, the next *Fourths*, &c. As let there be given a bullet of Lead, or ſuch like, whoſe weight let be 50 l. *Troy*, this call an unit, Integer, or thing; then with the like weight and matter make 10 other, the which together will be equal to 50 l. and will weigh each of them 5 l. a piece; take of the ſame matter, and equal to 5 l. make 10 more, then each of thoſe will weigh 6 ounces a piece; alſo if again you take 6 ounces and thereof make 10 other ſmall bullets each of them will weigh 12 peny weight *Troy*; and thus have you made *Primes*, *Seconds*, and *Thirds*, in reſpect of the Integer containing 50 l. *Troy* weight: So that 5 *Primes* is equall to the half maſs, and 2 *Primes* and 5 *Seconds*, is a quarter of the maſs; and therefore 1 of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diviſion, will be equal in weight to $\frac{1}{2}$ a quarter of the maſs and contain 6 l. and 3 ounces.

30. When

30. When a *decimal fraction* followeth a whole *number*, you are to seperate or part the *decimal* from the *whole number* by a point or prick; so if .75 followed the *whole number* 32, set them thus 32.75. You will find that divers Authors have divers wayes in expressing mixt *numbers*, as thus, 32|75 or 32 $\frac{75}{100}$ or $\overset{..}{32.75}$ but you will find that 32.75 thus placed and expressed is fittest for Calculation.

31, A mixt *Number* hath 2 parts, the whole and the broken; the whole is that which is composed of Integers, and the broken is a fraction annexed thereunto. So the mixt *Number* 36 $\frac{8}{12}$ being given we say that 36 is the whole *Number*, which is composed of Integers, and the $\frac{8}{12}$ is the broken *Number* annexed, which sheweth that one of the former Integers (of that 36) being divided into 12 parts, this $\frac{8}{12}$ doth express 8 of those 12 parts more belonging to the said 36 Integers.

32. *Denominative Numbers* are of one, or of many, and those are of diverse sorts and kinds, *viz.* *Singular* called unit, as 1; and *Plural* called multitude as 2, 3, 4, 5: *Single* of one kind only, called *digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9, and *Compound* of many, as 10, 11, 12, *&c.* 102, 367, *&c.*

Proportional as single, Multiple, Double, Triple,

Triple, Quadruple, *&c.* Denominate as Pounds, Shillings, Pence; Undenominate as 1, 2, 3; *&c.* Perfect as 6, 28, 496, 8128, 130816, 2096128, *&c.* Whose parts are equal to the numbers; Imperfect, unequal and more in the sum as 12 to 1, 2, 3, 4, 6. Imperfect, unequal and less than the sum, as 8 to 1, 2, 4. Numbers Commensurable and Incommensurable, as 12 and 9 are Commensurable because three measures them both.

But 6 and 17 are Incommensurable because no one Common *number* or *measure* can measure them; Linear in form of a line, as ..... Superficial in form of a Superficies or plane, as ⁘ or ⁞⁞ &c. and number Cubical or Solid in form of a Cube. These two latter are otherwise called figurative numbers: There are also other numbers called Tabular, as Sines, Tangents, Secants, &c. Others that be called Logarithmetick or borrowed numbers, fitted to proportion for ease and speedy Calculation of all manner of Questions.

CHAP.

CHAP. II.

Of the Natural Diviſion of Integers, and the ſeveral Denominations of their parts.

1. BEfore we come to Calculation or the ordering of *Numbers* to operate any Arithmetical Queſtion propoſed, we will lay down Tables of the Denomination of ſeveral Integers; and after that (having mentioned the ſeveral Species or kinds of Arithmetick) we ſhall immediately handle the Species of Numeration, which are the main Pillars upon which the whole Fabrick of this Art is built.

Of Money, Weights, &c.

2. The leaſt Denomination or Fraction of money uſed in *England* is a farthing, from

from whence is produced the following Tables, called the Tables of Coyn, (*viz.*)

1 *farthing* 4 *farthings* 12 *Pence* 20 *Shillings*	make	1 *farthing* 1 *Penny* 1 *ſhilling* 1 *Pound*	and therefore l. s. d qrs 1—20—12—4 1—20·240·960 1—12—48 1—4	

The firſt of theſe Tables *viz.* that on the left hand is plain and eaſie to be underſtood, and therefore wants no directions. In the ſecond Table above the line you have 1 *l.* 20 *s.* 12 *d.* 4 *qts.* whereby is meant that 1 pound is equal to 20 ſhillings, and one ſhilling is equal to 12 pence, and one peny equal to 4 farthings, under the line is 1 *l.* 20 *s.* 240 *d.* 960 *qts.* which ſignifies one pound to contain 20 ſhillings or 240 pence, or 960 farthings; in the ſecond line below that is 1 *s.* 12 *d.* 48 *qts.* the firſt ſtanding under the denomination of ſhillings, whereby is to be noted that one ſhilling is equal to 12 pence, or 48 farthings, and likewiſe that below, that one peny is equal in value to four farthings; underſtand the like reaſon in all the following Tables of weight, meaſure, time, motion, and dozen.

Troy

Troy weight.

3. The leaſt Fraction or Denomination of weight uſed in *England* is a grain of wheat gathered out of the middle of the ear, and well dryed; from whence are produced theſe following Tables of weight, called *Troy weight.*

32 *Grains of wheat*	make	24 *Artificial grains*
24 *Artificial graines*	make	1 *Penny weight*
20 *Peny-weight*	make	1 *Ounce*
12 *Ounces*	make	1 *Pound Troy weight*

And Therefore.

l.	*oun.*	*dra.*	*grains.*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy Weight ſerveth only to weigh Bread, Gold, ſilver, and Electuaries; it alſo regulateth, and preſcribeth a form how to keep the money of *England* at a certain ſtandard. The Goldſmiths have devided the ounce *Troy weight* into other parts, which they generally call mark weight, the denominative parts thereof are as followeth, *viz.* A mark (being an ounce Troy) is divided into 24 equal parts, called Carects and each Carect into 4 grains, ſo that in a mark

mark are 96 Grains; by this weight they diſtinguiſh the different fineſs of their Gold, for if to the fineſt of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baſer mettle, with which they uſe to mix their Gold or ſilver to abate the fineſs thereof) both making when cold but an ounce, or 24 Carects, then this Gold is ſaid to be 22 Carects fine, for if it come to be Refined the 2 Carects of alloy will fly away and leave only 22 Carects of pure Gold, the like to be conſidered of a greater or leſſer quantity; And as the fineſs of gold is eſtimated by Carects, ſo the fineſs of ſilver is diſtinguiſhed by ounces, for if a pound of it be pure, and looſeth nothing in the Refining, ſuch ſilver is ſaid to be twelve ounces fine, but if it looſeth any thing, it is ſaid to contain ſo much fineneſs as the loſs wanteth of 12 ounces, as if it loſe an ounce, it is ſaid to be 11 ounces fine, and if it loſe one ounce 14 peny weight, then it is ſaid to be 10 ounces 6 peny weight fine, and that which loſeth two ounces four penny weight 16 grains, is ſaid to be nine ounces 15 penny weight 8 grains fine, &c. the like of a greater or leſſer quantity.

Apothecaries weights.

4. The *Apothecaries* have their weights deduced

deduced from Troy weight, a pound *Troy* being he greateſt Integer, a Table of whoſe diviſion and ſub-diviſion followeth, *viz.*

1 *pound*		12 *ounces*	And therefore				
1 *ounce*	makes	8 *drams*	*l.*	*oun.*	*dram*	*ſcrup.*	*gr.*
1 *dram*		3 *ſcruples*	1	12	8	3	20
1 *ſcruple*		20 *grains*	1	12	96	218	5760
				1	8	24	480
					1	3	60
						1	20

§. Thus much concerning *Troy weight*, and its derivative weights (which as was ſaid before) ſerveth to weigh Bread, Gold, Silver, and Electuaries; now beſides Troy weight there is another kind of weight uſed in *England*, commonly known by the name of *Ave dupois* weight, (a pound of which is equal to 14 ounces 12 peny weight Troy weight) and it ſerveth to weigh all kindes of Grocery wares, as alſo butter, Cheeſe, Fleſh, Wax, Tallow, Rozen, Pitch, Lead, and all ſuch kind of garbel, the Table of which weight is as followeth.

The

The Table of Averdupois weight.

4 *quarters of a dram*	makes	*one dram*
16 *drams*		*one ounce*
16 *ounces*		*one pound*
28 *Pounds*		1 *quarter of a hundred*
4 *quarters*		1 *hund. weight, or* 112
20 *Hundred*		1 *Tun.*

And therefore.

Tun	*C.*	*qts.*	*l.*	*oun.*	*doz.*	*qts.*
1	20	4	28	16	16	4

1	20	80	2240	13440	215040	860160
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wooll is weighed with this weight, but only the divisions are not the same; A Table whereof followeth.

A Table

A Table of the denominative parts of Wool-weight.

7 *Pounds*		1 *Clove*
2 *Cloves*		1 *Stone*
2 *Stone*		1 *Todd*
6 *Todd* 1 *Stone*	make	1 *Wey*
2 *Weyes*		1 *Sack*
12 *Sacks*		1 *Last*

And Therefore

Last	*Sacks*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	6½	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	6½	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note that in some Countreys the *Wey* is 256 *l. Averdupois*, as is the *Suffolk Wey*; But in *Essex* there is 336 *l.* in a *Wey*.

6. The least Denominative part of Liquid measure is a Pint, and it is taken from *Troy weight*, because 1 pound of wheat *Troy weight* makes 1 Pint liquid: A Table of which Measure followeth.

The Table of Liquid Measure.

1 *pound of wheat Troy*	make	1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
8 *gallons*		1 *firk. of ale, ſope, or herr.*
9 *gallons*		1 *firkin of beer*
10 *gallons and a half*		1 *firk. of Salmon or Eeles*
2 *firkins*		1 *Kilderkin*
2 *Kilderkins*		1 *barrel*
42 *gallons*		1 *Tierce of wine*
63 *gallons*		1 *hogshead*
2 *hogsheads*		1 *pipe or butt*
2 *pipes or butts*		1 *Tunn of wine*

And Therefore.

Tun	*pipes*	*hhds*	*gall.*	*pts*	*grains of wh.*
1	2	2	63	8	7680
1	2	4	252	2016	15482880
	1	2	126	1008	7741440
		1	63	504	3870720
			1	8	61440
				1	7680

Thus you ſee that according to the ſtandard of *England* a pint doth contain 7680 grains of Natural wheat, but whoſoever ſhall try the wheat growing in *Norfolk*, ſhall find a Concave inch (that is a hollow, or hole made juſt the bigneſs of an inch) to contain 280 kernels of wheat, and if you

admit of $28\frac{7}{8}$ ſolid Inches in a pint, which according to the Judgment of Artiſts, is the content of a pint wine-meaſure (the leaſt of all meaſures) then a pint of ſuch meaſure will contain 8085 grains of wheat; which is very different from the ſtandard, but theſe things Quere.

7. The leaſt Denominative part of dry meaſure is alſo a pint, and this is likewiſe taken from *Troy weight*. The Table of whoſe diviſion followeth.

The Table of Dry Meaſure.

1 *pint*		1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
2 *gallons*		1 *peck*
4 *pecks*	make	1 *buſhel*
4 *buſhels*		1 *Comb*
2 *Combs*		1 *quarter*
4 *quarters*		1 *Chalder*
5 *quarters*		1 *Wey*
2 *Wey's*		1 *Laſt*

And therefore.

last	*wey*	*qts*	*com.*	*bush.*	*peck*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	5	10	40	160	320	2560
		1	2	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The leaſt Denominative part of *Long Meaſure* is a Barley-corn well dryed and taken out of the middle of the ear: whoſe Table of parts followeth.

The Table of Long Meaſure.

	make	
3 *barley cornes*		*an Inch*
12 *Inches*		1 *foot*
3 *feet*		1 *yard*
3 *feet 9 inches or a yard and quart.*		1 *Ell Engliſh*
6 *feet*		1 *fadom*
5 *yards and an half*		1 *pole or perch*
40 *poles or perches*		1 *furlong*
8 *furlongs*		1 *Engliſh mile*

And Therefore.

mile	*furl.*	*poles*	*yards*	*feet*	*Inches*	*barl.corns*
1	8	40	$5\frac{1}{2}$	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	$5\frac{1}{2}$	$16\frac{1}{2}$	198	594
			1	3	36	108
				1	12	36
					1	3

And note that the yard, as alſo the ell, is uſually divided into 4 quarters, and each quarter into 4 Nailes.

Note alſo, that a Geometrical pace is 5 feet; and there are 1056 ſuch paces in an *Engliſh* mile.

9. The parts of the Superficial meaſures of land, are ſuch as are mentioned in the following Table, *viz.*

The Table of Land Meaſure.

40 *Square Poles or Perches* } make { 1 *Rood or quarter of an Acre.*
4 *Roods* } make { 1 *Acre.*

By the foregoing Table of long Meaſure you are Informed what a pole, or (which is all one) perch is; and by this that 40 ſquare perches are 1 Rood. Now a ſquare perch

is a Superficies very aptly resembled by a square Trencher, every side thereof being a Perch or 5 Yards and a half in length, 40 of them is a Rood, and 4 Roods an Acre. So that a Superficies that is 40 perches long and 4 broad is an Acre of land the Acre containing in all 160 square Perches.

10. The least Denominative part of Time is a Minute, the greatest Integer being a Year; from whence is produced this following Table.

The Table of Time.

1 *Minute*	make	1 *Minute*
60 *Minutes*		1 *Hour*
24 *Houres*		1 *Day natural*
7 *Dayes*		1 *Week*
4 *Weeks*		1 *Moneth*
13 *moneths* 1 *day & 6 hours*		1 *Year.*

But the year is usually divided into 12 unequal Calendar Moneths, whose names and the number of Days that they Contain, follow, *viz.*

Jan-

	days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	31

So that the year containeth 365 days, and 6 hours, but the 6 hours is not reckoned but onely every 4 year, and then there is a day added to the latter end of *February*, and then it containeth 29 days, and that year is called Leap-year, and containeth 366 days.

And here Note, that as the Hour is divided into 60 Minutes, so each Minute is subdivided into 60 *Seconds*, and each *Second* into 60 *Thirds*, and each *Third* into 60 *Fourths*, &c.

The Tropical year by the exactest observations of the most accurate Astronomers, is found to be 365 Days, 5 Hours, 49 Minutes, 4 *Seconds* and 21 *Thirds*.

CHAP.

CHAP. III.

Of the Species or Kinds of Arithmetick.

1. ARithmetick is either Natural, Artificial, Analiticall, Algebraical, Lineal, or Inſtrumental.

2. Natural Arithmetick, is that which is performed by the Numbers themſelves; and this is either Poſitive or Negative. Poſitive which is wrought by certain infallible numbers propounded, and this is either ſingle or Comparative; Single, which conſidereth the nature of *numbers* ſimply by themſelves; and Comparative which is wrought by *numbers* as they have Relation one to another. And the Negative part relates to the Rule of *Falſe*.

3. Artificial (by ſome called Logarithmetical) Arithmetick is that which is performed by Artificial or borrowed *numbers* invented for that purpoſe, and are called Logarithmes.

4. Analiticall Arithmetick, is that which ſhews from a thing unknown, to find truly that which is ſought; always keeping the Species without Change.

5. Algebraical Arithmetick, is an obſcure and hidden art of Accompting by numbers in reſolving of hard Queſtions.

6. Lineal Arithmetick, is that which is performed by lines, fitted to proportions as alſo Geometrical projections.

7. Inſtrumental Arithmetick, is that which is Performed by Inſtruments, fitted with Circular and Right lines of proportions, by the motion of an Index or otherwiſe.

8. The parts of ſingle Arithmetick are Numeration and the Extraction of Roots.

9. Numeration is that which by certain known numbers propounded, we diſcover another Number unknown.

10. Numeration hath four Species; *viz.* Addition, Subtraction, Multiplication, and Diviſion,

CHAP.

CHAP. IV.

Of Addition of whole Numbers.

1. ADdition is the Reduction of two, or more *numbers* of like kind together into one Sum or Total. Or it is that by which divers *numbers* are added together, to the end that the Sum or Total value of them all may be discovered.

The first *number* in every addition is called the Addable *number*, the other, the *number* or *numbers* added, and the *number* invented by the *Addition* is called the *Aggregate* or *Sum*, containing the value of the *Addition*.

The Collation of the *numbers*, is the right placing of the *numbers* given respectively to each denomination; And the Operation is the Artificial adding of the *numbers* given together in order to the finding out of the *Aggregate* or Sum.

2. In Addition, place the *numbers* given reſpectively the one above the other, in ſuch ſort, that the like degree, place, or denomination may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, Hundreds under Hundreds, *&c.* Pounds under Pounds, Shillings under Shillings, Pence under Pence, *&c.* Yards under Yards, Feet under Feet, *&c.*

3. Having thus placed the *numbers* given (as before) and drawn a line under them, Add them together, beginning with the leſſer denomination, *viz.* at the right hand and ſo on, ſubſcribing the ſum under the line Reſpectively; as for Example.

Let there be given 3352 and 213 and 133 to be added together, I ſet the Units in each particular *number* under each other, and ſo likewiſe the Tens under the Tens, *&c.* and draw a line under them as in the margent, then I begin at the place of Units and add them together upwards ſaying, 3 and 3 are 6 and 2 make 8, which I ſet under the line, and under the ſame figures added together; then I proceed to the next place, being the place of Tens, and add them up in the ſame manner as I did the place of Units, ſaying 3 and 1 are 4 and 5 are 9, which I likewiſe ſet

3352
213
133
3698

ſet under the line Reſpectively; then I go to the place of Hundreds, and add them up as I did the other, ſaying 1 and 2 are 3 and 3 are 6, which I alſo ſet under the line; and laſtly I go to the place of Thouſands, and becauſe there are no other figures to add to the 3, I ſet it under the line in its reſpective place, and ſo the work is finiſhed; and I find the ſum of the 3 given numbers to be 3698.

4. But if the ſum of the figures of any Series exceeds ten, or any *number* of tens, ſubſcribe under the ſame the Exceſs above the tens, and for every ten carry one to be added to the next Series towards the left hand, and ſo go on until you have finiſhed your addition; alwayes remembring, that how great ſoever the ſum of the figures of the laſt Series is, it muſt all be ſet down under the line Reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed and as in the margent, with a line drawn under them, then I begin and add them, ſaying 7 and 8 are 15 which is 5 above ten, I ſet 5 under the line, and carry 1 for the ten to be added to the next Series, ſaying 1 that I carried and 5 is 6 and 7 are 13 I ſet down 3 and carry 1 for the ten, then to the next Series, I ſay 1 that I carried and 3

3678
2357
6035

are 4 and 6 are ten, now becauſe it come to juſt 10 and no more, I ſet 0 under the line and carry 1 for the ten to the next, and ſay 1 that I carried and 2 are 3 and 3 are 6 which I ſet down in its Reſpective place, thus the addition is ended, and the total Sum of theſe *numbers* is found to be 6035, ſeveral Examples of this kind follow.

Numbers to be added	354867
	573846
	785946
	347205
Sum	2061864

Numbers to be added.	748647
	465834
	76483
	648300
Sum	1939264

Numbers to be added.	45346
	38074
	8437
	923
	76
Sum	92856

5. If the Numbers given to be added are contained under divers denominations, as of Pounds, Shillings, Pence and Farthings, or of Tuns, Hundreds, Quarters, Pounds, *&c.* Then in this caſe having diſpoſed of the *numbers*, each denomination under other

ther of like kind; begin at the leaſt denomination, (minding how many of one denomination do make an Integer in the next) and having added them up, for every Integer of the next greater denomination that you find therein contained, bear a unit in mind to be added to the ſaid next greater denomination, expreſſing the exceſs reſpectively under the line, proceed in this manner untill your addition be finiſhed, the following Examples will make the Rule plain to the learner. Thus theſe ſeveral ſums being given to be added, *viz.* 136 l. 13 s. 4 d. 2 qrs. and 79 l. 07 s. 10 d. 3 qrs. and 33 l. 18 s. 09 d. 1 qrs. alſo 15 l. 9 s. 5 d. 0 qrs. The *numbers* being diſpoſed according to order will ſtand as in the Margent. Then I begin at the denomination of Farthings and add them up, ſaying 1 and 3 are 4 & 2 make 6, now I conſider that 6 Farthings, is 1 peny and 2 farthings, wherefore I ſet down the 2 Farthings in its place under the line, and keep 1 in mind to be added to the next denomination of Pence; then I go on, ſaying 1 that I carried and 5 are 6 and 9 are 15 and 10 are 25 and 4 are 29, now I conſider that 29 pence are 2 ſhillings and 5 pence, wherefore I ſet the

l.	s.	d.	qrs.
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2

the 5 pence in order under the line and keep 2 in mind for the 2 ſhillings, to be added to the ſhillings; then I go on ſaying, 2 that I carried, and 9 are 11, and 18 are 29, and 7 are 36, and 13 are 49; then I conſider that 49 ſhillings are 2 Pounds and 9 ſhillings, wherefore I ſet the 9 ſhillings under the line, and carry 2 for the 2 pounds, to the next and laſt denomination of pounds, and proceed ſaying, 2 that I carried, and 5 make 7. and 3 are 10, and 9 are 19, and 6 are 25; I then ſet down 5 and carry 2 for the 2 tens and proceed ſaying 2 that I carry and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16; I ſet down 6 and carry 1 for the ten, and go on ſaying 1 that I carried and 1 are 2 which I ſet in its place under the line, and the work is finiſhed, and thus I find the Sum of the fore-ſaid *Numbers* to be 265 l. 09 s. 05 d. 2 qrs. This to the Ingenious practitioner is ſufficient, but I ſhall (for the further illuminating of weaker apprehenſions) explain the operation of another Example in *Troy weight*; and here the Learner muſt take notice of the Table of *Troy weight*, mentioned or ſet down in the third Section of the ſecond Chapter. The *numbers* given in this Example, are 38 *l.* 07 *oz.* 13 *p.w.* 18 *gr.* And 50 *l.* 10 *oz.* 10 *p.w.* 12 *gr.* And 42 *l.* 08 *oz.* 05 *p.w.* 16 *gr.*

And

And in order to the Addition thereof, I place them as you ſee, and proceed to operation; ſaying 16 and 12 are 28, and 18 are 46; now becauſe 24 *grains* make 1 *peny weight*, 46 *grains* are 1 *peny weight* and 22 *grains*; wherefore I ſet down 22, and carry 1 for the *peny weight*, and going on I ſay one that I carry and 5 make 6, and 10 are 16, and 13 are 29, which is 1 ounce and 9 *peny weight*; I ſet down 9 in its place under the line, and carry 1 to the *ounces*, ſaying 1 that I carry and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 *ounces* make 2 *pound* 2 *ounces*, I ſet down 2 for the *ounces*, and carry 2 to the *pounds*; going on, 2 that I carry and 2 are 4, and 8 make 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10, and 3 are 13, which I ſet down as in the Margent, and the work is finiſhed, and I find the ſum of the ſaid *numbers* to amount to 132 *l.* 02 *oz.* 09 *p.w.* 22 *gr.* This is ſufficient for the underſtanding of the following Examples, or any other that ſhall come to thy view. The way of proving theſe or any ſums in this Rule is ſhewed Immediately after the enſuing Examples.

l.	*oz.*	*p.w.*	*gr.*
38	07	13	18
50	10	10	12
42	08	05	16
132	02	09	22

Addition

Addition of Engliſh money.

l.	*s.*	*d.*	*qrs.*
436	13	07	1
184	09	10	3
768	17	04	2
564	11	11	0
1954	12	09	2

l.	*s.*	*d.*	*qrs.*
48	15	11	1
76	10	07	3
18	00	05	3
24	19	09	2
168	06	10	1

Addition of Troy weight.

l.	*oun.*	*p.w.*	*gr.*
15	07	13	12
18	06	04	20
11	10	16	18
09	04	10	22
19	11	18	04
22	00	00	00
97	05	04	04

l.	*oun.*	*p.w.*	*gr.*
145	09	12	18
726	08	14	10
380	07	06	13
83	10	16	20
130	00	10	12
74	07	15	00
1541	08	16	01

Addition of Apothecaries weights.

l.	*oun.*	*dr.*	*ſcr.*	*gr.*
48	07	1	0	14
74	05	5	2	10
64	10	7	1	16
17	08	1	0	11
34	09	6	1	09
240	05	6	1	00

l.	*oun.*	*dr.*	*ſcru.*	*gr.*
60	03	4	0	10
48	10	6	0	14
34	08	2	1	15
18	11	2	2	11
160	07	1	2	15
35	02	5	1	07
358	07	7	0	12

Addition

Addition of Averdupois weight.

Tun	*C.*	*qrs.*	*l.*	*l.*	*oun.*	*dr.*
75	13	1	15	36	10	12
48	07	3	21	22	11	13
60	11	1	17	11	07	04
21	07	0	25	15	04	10
12	16	0	11	20	00	09
218	16	0	05	106	03	00

Addition of Liquid Measure.

Tun	*Pipe*	*hhd.*	*gall.*	*Tun*	*hhds*	*gall.*	*pts.*
45	1	1	48	30	3	40	4
15	0	1	17	12	0	28	6
38	0	0	47	47	5	60	5
12	1	0	56	57	3	22	3
21	1	1	18	17	0	00	0
133	1	1	60	166	1	26	2

Addition of Dry Measure.

Chald.	*qrs.*	*bush.*	*pec.*	*qrs.*	*bush.*	*pec.*	*gall.*
48	3	7	3	17	3	1	1
13	1	4	0	50	1	3	0
54	0	6	2	14	5	3	1
16	3	6	1	40	2	0	1
40	1	0	1	30	0	3	0
173	3	0	3	152	5	3	1

Addition

Addition of Long Measure.

yds	*qrs.*	*na.*	*els*	*qrs.*	*na.*
35	3	3	56	1	3
14	1	2	13	3	2
74	2	3	48	2	1
48	0	1	50	1	0
30	1	0	74	0	2
15	0	0	17	1	0
218	1	1	260	2	0

Addition of Land Measure.

Acre	*Rood*	*per.*	*Acr.*	*Rood*	*Perch:*
12	3	18	86	1	36
14	0	24	47	3	24
30	2	19	73	2	18
48	3	30	60	0	07
28	1	38	04	2	08
50	3	26	14	1	14
185	3	35	286	3	27

The proof of Addition.

6. *Addition* is proved after this manner, when you have found out the ſum of the *Numbers* given, then ſeparate the uppermoſt line from the reſt, with a ſtroke or daſh of the pen, and then add them all up again as you did before, leaving out the up-

uppermoſt line, and having ſo done add this new invented Sum to the uppermoſt line you ſeparated, and if the Sum of thoſe two lines be equal to the Sum firſt found out, then the work was performed true, otherwiſe not, As for Example, let us prove the firſt example of *Addition* of money whoſe ſum we found to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs*, and which we prove thus, having ſeparated the uppermoſt number from the reſt, by a line as you ſee in the margent, then I add the ſame together again, leaving out the ſaid uppermoſt line, and the ſums thereof, I ſet under the firſt Sum, or true ſum, which doth amount to 128 *l.* 16 *s.* 01 *d.* 0 *qrs.* then again I add this new Sum to the uppermoſt line that before was ſeparated from the reſt, and the Sum of theſe two is 265 *l.* 9 *s.* 05 *d.* 2 *qrs.* the ſame with the firſt Sum, and therefore I conclude that the operation was rightly performed.

l.	*s.*	*d.*	*qts.*
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	09	05	2

7. The main end of *Addition* in Queſtions Reſolvable thereby to know the ſum of ſeve-

ſeveral debts, parcels, Integers, *&c.* ſome Queſtions may be theſe that follow

Queſt. 1. There was an old man whoſe age was required, to which he replyed, I have ſeven ſons each having two years between the birth of each other, and in the 44 year of my age my eldeſt ſon was born, which is now the age of my youngeſt; I demand what was the old mans age?

Now to Reſolve this Queſtion, firſt ſet down the fathers age at the birth of his firſt child, which was 44, then the difference between the eldeſt and the youngeſt, which is 12 years, and then the age of the youngeſt which is 44, and then add them all together, and their ſum is 100, the compleate age of the Father.

44
12
44
100

Queſt. 2. A man lent his friend at ſeveralltimes, theſe ſeveral ſums, (*viz.*) at one time 63 *l.* at another time 50 *l.* at another time 48 *l.* at another time 156 *l.* now I deſire to know how much was lent him in all.

Set

Set the ſums lent one under another, as you ſee in the margent, and then add them together, and you will find their ſum to amount to 317 *l.* which is the Total of all the ſeveral ſums lent, and ſo much is due to the Creditor.

l.
63
50
48
156
317

Queſt. 3. From *London* to *Ware* is 20 miles, thence to *Huntington* 29 miles, thence to *Standford* 21, thence to *Tuxford* 36 miles, thence to *Wentbridge* 25 miles, from thence to *York* 20 miles. Now I deſire to know how many miles it is from *London* to *York* according to this Reckoning?

Now to anſwer this Queſtion, ſet down the ſeveral diſtances given as you ſee in the margent, and add them together, and you will finde their ſum to amount to 151, which is the true diſtance in miles between *London* and *York*.

20
29
21
36
25
20
151

Queſt. 4. There are 2 numbers the leaſt whereof is 40, and their difference is 14, I deſire to know what is the greater number, and alſo what is the ſum of them both?

First

First set down the least *viz.* 40, and 14 the difference, and add them together, and their sum is 54 for the greatest number, then I set 40, (the least) under 54, (the greatest) and add them together, and their sum is 94, equal to the greatest and least numbers.

	40
	14
greatest	54
least	40
sum	94

CHAP. V.

Of Subtraction of whole Numbers.

1. *Subtraction* is the taking of a lesser number out of a greater of like kind, whereby to find out a third number, being or declaring the Inequality, excess, or difference between the numbers given, or *Subtraction* is that by which one number is taken out of another number, given to the

the end that the reſidue, or remainder may be known, which remainder is alſo called the reſt or difference of the numbers given.

2. The number out of which *Subtraction* is to be made, muſt be greater, or at leaſt equal with the other number given, the higher or ſuperiour number is called the major number, and the lower or inferiour is called the minor number, and the operation of *Subtraction* being finiſhed, the reſt or remainder is called the difference of the numbers given.

3. In *Subtraction* place the numbers given reſpectively, the one under the other, in ſuch ſort as like degrees, places, or denominations may ſtand in the ſame Series, *viz.* Units under units, Tens under Tens, *&c.* Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done, draw a line underneath, as in *Addition.*

4. Having placed the *numbers* given as is before directed, and drawn a line under them, Subſtract the lower number, (which in this caſe muſt alwayes be leſſer than the uppermoſt) out of the higher *number*, and ſubſcribe the difference, or remainder, reſpectively below the line; and when the work is finiſhed, the number below the line

line will give you the Remainder; As for Example, let 364521 be given to be Subtracted from 795836. I ſet the leſſer under the greater as in the margent, and draw a line under them, then beginning at the Right hand, I ſay 1 out of 6 and there Remains 5, which I ſet in order under the line; then I proceed to the next, ſaying 2 from 3 reſts 1, which I note alſo under the line, and thus I go on untill I have finiſhed the work, and then I find the Remainder or difference to be 431315.

795836	
364521	
431315	

5. But if it ſo happen (as commonly it doth) that the lowermoſt *number* or figure is greater then the uppermoſt; then in this caſe, add ten to the uppermoſt *number*, and Subtract the ſaid lowermoſt *number* from their ſum, and the remainder place under the line, and when you go to the next figure below, pay a unit by adding it thereto for the 10 you borrowed before, and ſubtract that from the higher *number* or figure: And thus go on untill your Subtraction be finiſhed. As for Example; Let 437503 be given, from whence it is required to ſubtract 153827, I diſpoſe of the *numbers* as is before directed, and as you ſee in the margent; then I begin, ſaying 7 from 3 I can-

cannot, but (adding 10 thereto I ſay) 7 from 13 and there Remains 6 which I ſet under the line in order; then I proceed to the next figure, ſaying I that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7, which I likewiſe ſet down as before; then one that I borrowed and eight is nine, from five I cannot, but nine from fifteen and there remains ſix; then one I borrowed and three is four, from ſeven and there remains three; then five from three I cannot, but five from thirteen and there remains eight; then one I borrowed and one are two, from four and there reſts two; And thus the work is finiſhed, and after theſe *numbers* are *Subtracted* one from another, the inequality, remainder, exceſs, or difference is found to be 283676. Examples for thy further experience may be theſe that follow.

437503			
153827			
283676			

From	3475016	*From*	3615746
Take	738642	*Take*	5864
Reſts	2736374	*Reſts*	3609882

6. If the *Sums* or *Numbers* to be *Subtracted*, are of ſeveral Denominations,

place the leſſer *Sum* below the greater, and in the ſame Rank and order as is ſhewed in Addition of the ſame *Numbers*; then begin at the Right-hand, and take the lower *number* out of the uppermoſt, if it be leſſer; but if it be bigger then the uppermoſt, then borrow a Unit from the next greater Denomination, and turn it into the parts of the leſſer Denomination, and add thoſe parts to the uppermoſt *Number*, and from their *Sum* ſubſtract the lowermoſt, noting the remainder below the line; then proceed and pay 1 to the next Denomination for that which you borrowed before, and proceed in this order untill the work be finiſhed, An Example of this Rule may be this that followeth; let 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* be given, from whence let it be required to *Subtract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto I place the *numbers* as you ſee in the margent, and thus I begin at the leaſt Denomination ſaying two from one I cannot, therefore I borrow one peny from the next denomination and turn it into farthings which is four, and adding four to one which is five I ſay, but two from five and there remains three, which I put under

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

the line; then going on, I say one that I borrowed and three is four, from 7 and there Rests three; then going on, I say sixteen from thirteen I cannot, but (borrowing one pound and turning it into twenty shillings; I add it to thirteen and that is thirty three, wherefore I say) sixteen from thirty three, and there remains seventeen, which I set under the line and go on, saying one that I borrowed and seven is eight, from five I cannot, but eight from fifteen and there remains seven; then one that I borrowed and five is six, from seven there Rests one, and nothing from three Rests three, and the work is done; And I find the remainder or difference to be 3 17 *l.* 17 *s.* 03 *d.* 3 *qrs.*

Another Example of *Troy weight* may be this, I would *Subtract* 17 *l.* 10 *oz.* 11 *p.w.* 20 *gr.* from 24 *l.* 05 *oz.* 00 *p.w.* 08 *gr.* I place the *numbers* according to Rule and begin, saying twenty from eight I cannot, but borrow one *peny weight* which is twenty four *grains*, and add them to eight and they are thirty two, wherefore I say twenty from thirty two Rests twelve; then one that I borrowed and eleven is twelve, from 00 I cannot, but twelve from twenty (borrowing

l.	*oz.*	*p.w.*	*gr.*
24	05	00	08
17	10	11	20
06	06	08	12

rowing an ounce which is twenty *peny weight*) and there remains eight; then one that I borrowed and ten is eleven, from five I cannot, but eleven from seventeen and there rests six; then one that I borrowed and seven is eight, from four I cannot but eight from fourteen and there Rests six; then one that I borrowed and one is two from two and there rests nothing; so that I find the Remainder or difference to be 6*l.* 6 *oz.* 8 *p.w.* 12 *gr.*

7. It many times happeneth that you have many *Sums* or *Numbers* to be *Subtracted* from one *number*; as suppose a man should lend his friend a certain *Sum* of Money, and his friend had paid him part of his debt at several times, then before you can conveniently know what is still owing you are to add the several *Numbers* or *Sums* of Payment together, and *Subtract* their *Sum* from the whole Debt, and the Remainder is the *Sum* due to the Creditor, as Suppose A lendeth to B 564 *l.* 13 *s.* 10 *d.* and B hath Repaid him 79 *l.* 16 *s.* 08 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l.* 15 *s.* 08 *d.* at another time; and you would know how the Accompt standeth between them, or what more is due to A. In order whereunto I first set down the *Sum* which A lent

and

and draw a line underneath it, then under that line ſet the ſeveral *Sums* of payment as you ſee in the margent; and having brought the ſeveral *Sums* of payment into one Total by the 5th. Rule of the 4th. Chapter foregoing, I find their *Sum* amounteth to 485 *l.* 11 *s.* 3 *d.* which I *Subtract* from the ſum firſt lent by A by the 6th Rule of this Chapter, and I find the Remainder to be 79 *l.* 02 *s.* 07 *d.* And ſo much is ſtill due to A.

	l.	*s.*	*d.*
Lent	564	13	10
paid at ſeveral paym.	79	16	08
	163	18	11
	241	15	08
paid in all	485	11	03
Remaines	79	02	07

When the Learner hath good knowledge of what hath been already delivered, in this and the foregoing Chapter, he will with eaſe underſtand the manner of working the following Examples.

rowing an ounce which is twenty *peny weight*) and there remains eight; then one that I borrowed and ten is eleven, from five I cannot, but eleven from seventeen and there rests six; then one that I borrowed and seven is eight, from four I cannot but eight from fourteen and there Rests six; then one that I borrowed and one is two from two and there rests nothing; so that I find the Remainder or difference to be 6*l.* 6 *oz.* 8 *p.w.* 12 *gr.*

7. It many times happeneth that you have many *Sums* or *Numbers* to be *Subtracted* from one *number*; as suppose a man should lend his friend a certain *Sum* of Money, and his friend had paid him part of his debt at several times, then before you can conveniently know what is still owing you are to add the several *Numbers* or *Sums* of Payment together, and *Subtract* their *Sum* from the whole Debt, and the Remainder is the *Sum* due to the Creditor, as Suppose A lendeth to B 564 *l.* 13 *s.* 10 *d.* and B hath Repaid him 79 *l.* 16 *s.* 08 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l.* 15 *s.* 08 *d.* at another time; and you would know how the Accompt standeth between them, or what more is due to A. In order whereunto I first set down the *Sum* which A lent,

and

and draw a line underneath it, then under that line ſet the ſeveral *Sums* of payment as you ſee in the margent; and having brought the ſeveral *Sums* of payment into one Total by the 5th. Rule of the 4th. Chapter foregoing, I find their *Sum* amounteth to 485 *l.* 11 *s.* 3 *d.* which I *Subtract* from the ſum firſt lent by A by the 6th Rule of this Chapter, and I find the Remainder to be 79 *l.* 02 *s.* 07 *d.* And ſo much is ſtill due to A.

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Remaines	79	02	07

When the Learner hath good knowledge of what hath been already delivered, in this and the foregoing Chapter, he will with eaſe underſtand the manner of working the following Examples.

Subtraction of Money.

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs.*
Borrowed	374	10	03	700	10	11	2
Paid	79	15	11	9	03	11	3
Remaines	294	14	04	691	06	11	3

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs.*
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Rem. due	980	19	06	699	09	11	3

	l.	*s.*	*d.*	*qrs.*
Borrowed	3300	00	00	0
Paid at several payments.	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	02	3
Remain due	2104	07	09	1

Subtraction of Troy weight.

	l.	*oz.*	*p w.*	*gr.*
Bought	174	00	13	00
Sould	78	04	16	15
Remaines	95	07	16	09

Bought

	l.	*oz.*	*p.w.*	*gr.*
Bought	470	10	13	00
Sold at several Times	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Rem. unsold	225	00	05	17

Subtraction of Apothecaries weight.

	l.	*oz.*	*dr.*	*scr.*	*gr.*	*l.*	*oz.*	*dr.*	*scr.*	*gr.*
Bought	12	04	3	0	00	20	00	1	0	07
Sold	8	05	1	1	15	10	00	1	2	12
Remains	3	11	1	1	05	9	11	7	0	15

Subſtraction of Averdupois weight.

	C.	*qrs.*	*l.*	*Tun*	*C:*	*qrs.*	*l.*	*oz.*	*dr.*
Bought	35	0	15	5	07	1	10	10	05
Sold	16	1	20	3	17	1	16	09	13
Rem.	18	2	23	1	09	3	22	00	08

Subtraction of Liquid Measure.

	Tun	hhd	gall.	Tun	hhd	gall.	pts.
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Subtraction of Dry Measures.

	Chal.	qrs.	bush.	pec.	Ch.	qrs.	bush.	pec.
Bought	100	0	00	0	73	2	3	2
Sold	54	1	04	3	46	2	3	3
Remains	45	2	03	1	26	3	7	3

Subtraction of Long Measure.

	Yards	qrs.	Nails	Yards	qrs.	Nails.
Bought	160	1	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Subtraction of Land Measure.

	Acres	Rood	perch.	Acre	Rood	perch.
Bought	140	2	13	600	0	00
Sold	70	3	22	54	0	16
Remains	69	2	31	545	3	24

The

The Proof of Subtraction.

8. When your *Subtraction* is ended, if you desire to prove your work, whether it be true or no, then add the remainder to the minor *number*, and if the *aggregate* of these two be equal to the major *number*, then was your operation true, otherwise false; thus let us prove the first *Example* of the fifth rule of this *Chapter*, where after *Subtraction* is ended the *numbers* stand as in the *Margent*, the remainder or difference being 283676 now to prove the work, I add the said remainder 283676 to the minor *number* 153827, by the fourth Rule of the foregoing *Chapter*, and I finde the sum or *aggregate* to be 437503 equal to the major number, or *number* from whence the lesser is *Subtracted*, behold the work in the *Margent*.

437503	
153827	
283676	
437503	
153827	
283676	
437503	

The proof of another *Example*, may be of the first *Example*, of the sixth *Rule* of this *Chapter* where it is required to *Subtract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 07 *d.* *qrs.* and by the *Rule* I find the *Remainder* to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* now to prove it, I add the said *Re-*

mainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor *number* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* and their summe is 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* equal to the major *number* which proves the work to be true, but if it had happened to have been either more or less than the said major *number*, then the *operation* had been false.

l.	*s.*	*d.*	*qrs*
375	13	07	1
57	16	03	2
317	17	03	3
375	13	07	1

9. The general effect of *Subtraction* is to find the difference or excess between two *numbers*, and the *Rest* of a payment made of a greater sum, the date of Books printed, the age of any thing by knowing the present year, and the year wherein they were made, created or built; and such like.

The Questions appropriated to this *Rule*, are such as follow.

Quest. 1. What difference is there between one thing of 125 foot long and another of 66 foot long?

To resolve this *Question*, I first set down the major or greater *number* 125, and under it the minor or lesser *number* 66, as is directed in the third *rule* of this *Chapter*, and according to the fourth Rule

125
66
59

of

of the ſame, I *Subtract* the minor from the major, and the *Remainder*, exceſs, or difference I finde to be 59, ſee the work in the *Margent*.

Queſt. 2. A Gentleman oweth a *Merchant* 365 *l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an *Anſwer* to this *Queſtion*, I firſt ſet down the *major number*, 365 *l.* and under it I place 278 the *minor*, and *ſubtract* the one from the other, and thereby I diſcover the exceſs, difference, or remainder to be 87, and ſo much is ſtill due to the *Creditor*.

Queſt. 3. An obligation was written, book printed, a childe born, a Church built, or any other thing made, in the year of our Lord 1572, and now we Account the year of our Lord 1677, The *Queſtion* is to know the age of the ſaid things, that is how many years are paſſed ſince the ſaid things were made; I ſay if you *ſubtract* the leſſer *number* 1572, from the greater 1677, the Remainder will be 105. and ſo many years paſt are ſince the making of the ſaid things.

Queſt. 4. There are 3 Towns lye in a ſtreight line (*viz.*) *London*, *Huntington*, and *York*, now the diſtance between the fartheſt of theſe towns, *viz.* *London* and

York is 151 miles, and from *London* to *Huntington*, is 49 miles, I demand how far it is from *Huntington* to *York*.

To Resolve this *Question*, *subtract* 49 the distance between *London* and *Huntington*, from 151 the distance between *London* and *York*, and the remainder is 102, for the true distance between *Huntington* and *York*.

CHAP. VI.

Of Multiplication of whole Numbers.

1. *Multiplication* is performed by two *numbers*, of like or unlike kinde, for the *production* of a third, which shall have such reason to the one, as the other hath to unite, and in effect is a most brief and artificial compound *Addition* of many equal *numbers* of like kind into one sum. Or *Multiplication* is that by which we

Multiply

Multiply two or more *numbers*, the one into the other, to the end that their product may come forth, or be discovered.

Or *Multiplication* is the increasing of any one *number* by another, so often as there are unites in that *number*, by which the other is increased, or by having two *numbers* given to find a third, which shall contain one of the *Numbers* as many times as there are unites in the other.

2. *Multiplication* hath three parts, first the *Multiplicand*, or *number* to be *Multiplied*, Secondly, the *Multipliar*, or *number* given, by which the *multiplicand* is to be *multiplied*, and Thirdly, the *product* or *number* produced by the other two, the one being *multiplyed* by the other, as if 8 were given to be *multiplyed* by 4, I say 4 times 8 is 32, here 8 is the *multiplicand*, and 4 is the *multipliar*, and 32 is the product.

```
 8
 4
---
32
```

3. *Multiplication* is either single by one figure, or compound that consists of many.

Single *multiplication* is said to consist of one figure, because the *multiplicand* and *multipliar* consist each of them of a digit, and no more, so that the greatest product that can arise by single *multiplication* is 81, being

being the ſquare of 9; and Compound *multiplication* is ſaid to conſiſt of many figures, becauſe the *multiplicand* or *multiplier* conſiſt of more places than one; as if I were to *multiply* 436 by 6, it is called compound, becauſe the *multiplicand* 436 is of more places than one, (*viz.*) 3 places.

4. The Learner ought to have all the varieties of ſingle *multiplication* by heart before he can well proceed any further in this Art, it being of moſt excellent uſe, and none of the following Rules in *Arithmetick* but what have their principal dependance thereupon, and they may be learnt by the following Table.

Multiplication Table.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The

The uſe of the precedent Table is this, In the uppermoſt line or Collume you have expreſſed all the digits from 1 to 9, and likewiſe beginning at 1 and going downwards in theſide-colume you have the ſame; ſo that if you would know the product of any two ſingle *numbers* multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Collume, and for the other in the ſide Collume, and running your eye from each figure along the reſpective Collumes, in the common *Angle* (or *place*) where theſe two Collumes meet there is the product required. As for Example, I would know how much is 8 times 7, firſt I look for 8 in the uppermoſt Collume, and 7 in the ſide Collume, then do I caſt my eye from 8 along the Collume downwards from the ſame, and likewiſe from 7 in the ſide Collume, I caſt my eye from thence towards the right hand, and finde it to meet with the firſt Collume at 56, ſo that I conclude 56 to be the product required, it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide, the like is to be underſtood of any other ſuch *numbers*. The learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the

Multi-

Multiplicand consists of many places, and the *multipliar* of but one figure; first set down the *multiplicand*, and under it place the *multipliar* in the place of unites and draw a line underneath them, then begin and *multiply* the *multipliar* into every particular figure of the *multiplicand*, beginning at the place of units, and so proceed towards the left hand, settingeach particular product under the line, in order as you proceed, but if any of the products exceed 10 or any number of tens, set down the excess, and for every 10 carry a unite to be added to the next product, always remembring to set down the Total product of the last figure; which work being finished, the sum or number placed under the line shall be the true and totall product required. As for example, I would multiply 478 by 6, first I set down 478, and underneath it 6 in the place of units, and draw a line underneath them as in the Margent, then I begin saying 6 times 8 is 48, which is 8 above four tens, therefore I set down 8 (the excess) and bear 4 in mind for the four tens, then I proceed saying 6 times 7 is 42 and 4 that I carried is 46, I then set down 6 and carry 4, and go on saying 6 times 4 is 24, and 4 that

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 478
   6
2868
```

I

I carried is 28, and becauſe it is the laſt figure, I ſet it all down, and ſo the work is finiſhed, and the product is found to be 2868, as was required.

6. When in Compound *Multiplication* the Multipliar conſiſteth of divers places, then begin with the figure in the place of units in the Multipliar, and Multiply it into all the figures of the Multiplicand, placing the product below the line as was directed in the laſt Example, then begin with the figure in the ſecond place of the Multipliar (*viz.*) the place of tens, and Multiply it likewiſe into the whole Multiplicand (as you did the firſt figure) placing its product, under the product of the firſt figure, do in the ſame manner by the third, fourth, and fifth, *&c.* until you have Multiplied all the figures of the Multipliar particularly into the whole multiplicand, ſtill placing the product of each particular figure under the product of its precedent figure; herein obſerving the following Caution.

A Caution. In the placing of the product of each particular figure of the Multipliar, you are not to follow the 2 Rule of the fourth Chapter, *viz.* not to place units under units, and tens under tens, *&c.* but to put the figure or Cypher

Cypher in the place of Units of the ſecond line under the ſecond figure or place of Tens in the line above it, and the figure or Cypher in the place of units of the third line under the place of Tens in the ſecond line, *&c.* Obſerving this order till you have finiſhed the work, *viz.* ſtill placing the firſt figure of every line or product under the ſecond figure or place of Tens in that which is above it, and having ſo done, draw a line under all theſe particular products, and add them together; ſo ſhall the ſum of all theſe products be the total product Required.

As if it were Required to Multiply 764 by 27, I ſet them down the one under the other with a line drawn underneath them; then I begin ſaying ſeven times four is 28, then I ſet down 8 and Carry 2, then ſay 7 times 6 is 42 and 2 that I carried is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I ſet down becauſe I have not another figure to Multiply; Thus have I done with the 7; then I begin with the 2 ſaying 2 times 4 is 8, which I ſet down under the 4 the ſecond figure or place of tens in the line above it, as you may ſee in the margent; Then I proceed, ſaying 2 times 6 is 12 that is 2 and carry one, then two times

764
27
5348
1528
20628

times seven is fourteen, and one that I carry is fifteen, which I set down because 'tis the product of the last figure; so that the product of 764 by 7 is 5348, and by 2 is 1528 which being placed the one under the other as before is directed, and as you see in the margent, and a line drawn under them, and they added together Respectively, make 20628 the true product Required, being equal to 27 times 764.

Another Example may be this; Let it be Required to Multiply 5486 by 465, I dispose of the Multiplicand and Multiplier according to Rule, and begin Multiplying the first figure of the Multiplier, which is five, into the whole Multiplycand, and the product is 27430; then I proceed and Multiply the second figure (6) of the Multiplier into the Multiplicand and find the product to amount to 32916 which is subscribed under the other product Respectivly, then do I Multiply the third and last figure (4) of the Multiplier into the Multiplicand, and the product is 21944, which is likewise placed under the second line Respectively; then I draw a line under the said products (being placed the one under the other according to Rule) and add them to ge

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 5486
  465
-----
27430
32916
21944
-----
2550990
-----
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together and the sum is 2550990 the true product sought being equal to 5486 times 465, or 465 times 5486.

More Examples in this Rule are these following.

430865	6400753
4739	37496
3877785	38404548
1292595	57606822
3016055	25603032
1723460	44805306
2041869235	19202274
	240002821968

7. Although the foormer Rules are sufficient for all Cases in multiplication, yet because in the work of multiplication many times great labour may be saved, I shall acquaint the Learner therewith, *viz.* If the multiplicand or multiplier, or both of them end with Cyphers, then in your multiplying you may neglect the Cyphers, and multiply only the significant figures; and to the product of those significant figures; add so many Cyphers as the *Numbers* given to be multiplyed did end with; that

Si e numeris propositis unus vel uterque adjunctos habeat ad dextram circulos; omissis circulis fiat ipsorum numerorum multiplicatio, & facto demum tot insuper integrorum loci accenseanturquot sunt omissi circuli in utroque factore. *Clavis Math*: c. 4.

that is, annex them on the Right hand of the ſaid product, ſo ſhall that give you the true product Required. As if I were to multiply 32000 by 4300, I ſet them down in order to be multiplyed as you ſee in the margent, but neglecting the Cyphers in both numbers, I only multiply 32 by 43 and the product I find to be 1376, to which I annex the 5 Cyphers that are in the multiplicandand multiplier and then it makes 137600000 for the true product of 32000 by 4300.

32000
4300
96
128
137600000

8. If in the multiplier, Cyphers are placed between ſignificant figures, then multiply only by the ſignificant figures neglecting the cyphers, but here ſpecial notice is to be taken of the true placing of the firſt figure after the neglect of ſuch Cypher or Cyphers, and therefore you muſt obſerve in what place of the multiplier the figure you multiply by ſtandeth, and ſet the firſt figure of that product under the ſame place of the product of the firſt figure of your multiplier; As for Example, let it be Required to multiply 371568 by 40007, firſt I multiply the multiplicand by

Si intermedio multiplicantis loco circulus fuerit, ille negligitur. *Alſted: Cap. 6 de Arithm.*

by seven and the product is 2600976, then neglecting the Cyphers, I multiply by 4 and that product is 1486272 now I consider that four is the fifth figure in the multiplier, therefore I place two (the first figure of the Product by four) under the fifth place of the first Product by seven, and the rest in order, and having added them together, the total product is found to be 14865320976. other Examples in this Rule are these following.

371568
40007
2600976
1486272
14865320976

327586	7864371
6031	20604
982758	31457484
1965516	47186226
1975343580	15728742
	162037500084

9. If you are to multiply any *Number* by a unit with Cyphers, (*viz.*) by 10, 100, 1000, *&c.* Then prefix so many Cyphers before the multiplicand, and that *Number* when the Cyphers are prefixed is the Product Required; as if you would multiply 428 by 100, annex two Cyphers to 428 and it is 42800; If it were Required to multiply 102 by 10000, annex 4 Cyphers and

and it gives 1020000 for the Product Required.

The Proof of Multiplication.

10. Multiplication is Proved by Diviſion and to ſpeak truth all other wayes are falſe; and therefore it will be moſt convenient in the firſt place, to learn Diviſion and by that to prove Multiplication. There is a way (at this day generally uſed in Schools) to Prove multiplication, which is this, firſt add all the Figures in the multiplicand together, as if they were ſimple *Numbers*, caſting away the Nines as often as it comes to ſo much, and noting the Remainder at laſt, which in this caſe cannot be ſo much as 9, Caſt likewiſe the Nines out of the multiplier as you did out of the multiplicand, and note that Remainder; then multiply the Remainders the one by the other, and caſt the Nines out of that Product, obſerving the Remainder, and laſtly, Caſt the Nines out of the total product, and if this Remainder be equal to the Remainder laſt found, then they conclude the work to be Rightly performed; but there may be given a thouſand (nay infinite) falſe Products in a multiplication, which

Neque eſt quod aliam expectes examinandi viam; nam aliæ vulgares & falſæ ſunt, & nullo innixæ fundamento. *Gem. Friſ.*

which after this manner may be Proved to be true, and therefore this way of Proving doth not deserve any Example; but we shall deferr the Proof of this Rule till we come to Prove Division, and then we shall Prove them both together.

11. The general effect of Multiplication is contained in the definition of the same which is to find out a third *Number*, so often containing one of the two given *Numbers* as the other containeth unit.

The second effect is by having the length and breadth of any thing (as a pararellogram, or long plain) to find the superficial content of the same, and by having the superficial content of the base and the length, to find the solidity of any parallelepipedon, Cylinder ar other solid figures.

The third Effect is by the contents, price, vallue, buying, selling, expence, wages, exchange, simple Interest, gain, or loss of any one thing, be it Money, Merchandise, *&c.* to find out the value, price, expence, buying, selling, exchange, or Interest of any *Number* of things, of like Name, Nature and Kind.

The fourth Effect is (not much unlike the other (by the Contents, Vallue, or price of one part of any thing Denominated, to find out the Content, Vallue or Price of the whole

whole thing, all the parts into which the whole is divided, multiplying the price of one of thoſe parts.

The Fifth Effect is, to aid, to compound and to make other Rules, as chiefly the Rule of Proportion, called the Golden Rule, or Rule of three; alſo by it, things of one Denomination are reduced to another.

If you multiply any Number of Integers by the price of the Integer, the Product will diſcover the price of the Quantity, or Number of Integers given.

In a Rectangular Solid, if you multiply the bredth of the baſe by the depth, and that Product by the length, this laſt Product will diſcover the Solidity or content of the ſame Solid.

Some Queſtions proper to this Rule may be theſe following.

Queſt. 1. What is the content of a ſquare piece of ground, whoſe length is 28 *perches*, and bredth 13 *perches*.

Anſwer, 364 ſquare *perches*, for multiplying 28 the length, by 13 the bredth, the Product is ſo much.

Queſt. 2. There is a ſquare battail whoſe Flank is 47 men, and the files 19 deep,

what Number of men doth that battail contain? *Facit* 893, for multiplying 47 by 19, the Product is 893.

Queſt. 3. If any one thing coſt 4 ſhillings, what ſhall 9 ſuch things coſt? *Anſwer*, 36 ſhillings; for multiplying 4 by 9, the Product is 36.

Queſt. 4. If a piece of Money or Merchandize be worth or coſt 7 ſhillings, what ſhall 19 ſuch pieces of Money or Merchandize coſt? *Facit* 133 ſhillings, which is equal to 6 *l.* 13 *s.*

Queſt. 5. If a Souldier or Servant get or ſpend 14 *s. per* moneth, what is the Wages or Charges of 49 Souldiers or Servants for the ſame time? multiply 49 by 14 the Product is 686 *s.* for the *Anſwer.*

Queſt. 6. If in a day there are 24 hours, how many hours are there in a year, accounting 365 dayes to conſtitute the year? *Facit* 8760 hours to which if you add the 6 hours over and above 365 dayes as there is in a year, then it will be 8766 hours, now if you multiply this 8766 by 60 the Number of Minutes in an hour, it will produce 525960, for the Number of Minuts in a Year.

CHAP. VII.

Of Diviſion of whole Numbers.

1. DIVISION is the Separation, or Parting of any Number, or Quantity given, into any parts aſſigned; Or to find how often one Number is Contained in another; Or from any two Numbers given to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is Comprehended or contained in the other.

2. Diviſion hath three Parts, or Numbers Remarkable, *viz.* Firſt the Dividend, Secondly the Diviſor, and Thirdly the Quotient. The Dividend is the Number given to be Parted or Divided. The Diviſor is the Number given, by which the Dividend is divided; Or it is the Number which ſheweth how many parts the Dividend is to be divided into. And the Quotient is the Number Produced by the Diviſion of the

two given Numbers the one by the other.

So 12 being given to be divided by 3, or into three equal parts, the Quotient will be 4 for 3 is contained in 12 four times, where 12 is the Dividend; and 3 is the Divisor, and 4 is the Quotient.

3. In Division set down your Dividend, and draw a Crooked line at each end of it, and before the line at the left hand, place the Divisor, and behind that on the right hand, place the figures of the Quotient, as in the margent, where it is required to divide 12 by 3; First I set down 12 the Dividend, and on each side of it do I draw a crooked line, and before that on the left hand do I place 3 the Divisor; then do I seek how often 3 is contained in 12, and because I find it 4 times, I put 4 behind the Crooked line on the Right hand of the Dividend, denoting the Quotient.

```
3) 12 (4
```

4. But if the Divisor being a single Figure, the Dividend consisteth of two or more places, then (having placed them for the work as is before directed) put a point under the first Figure on the left hand of the Dividend, provided it be bigger then, (or equal to) the Divisor, but if it be lesser then the Divisor, then put a point under the second Figure from the left hand of the

the Dividend, which Figures as far as the point goeth from the left hand are to be Reckoned by themſelves, as if they had no dependance upon the other part of the Dividend, and for diſtinction ſake may be called the Dividual, then ask how often the Diviſor is contained in the Dividual, placing the anſwer in the Quotient; then multiply the Diviſor by the Figure that you placed in the Quotient and ſet the product thereof under the Dividual; then draw a line under that product, and Subtract the ſaid Product from the Dividual, placing the Remainder under the ſaid line, then put a point under the next figure in the Dividend, on the Right hand of that which you put the point before, and draw it down, placing it on the Right hand of the Remainder, which you found by Subtraction; which Remainder with the ſaid Figure annexed before it, ſhall be a new dividual; then ſeek again how often the diviſor is contained in this new dividual, and put the Anſwer in the Quotient on the Right hand of the Figure there before, then multiply the diviſor by the laſt Figure that you put in the Quotient, and ſubſcribe the Product under the dividual, and make Subtraction, and to the Remainder draw down the next Figure from the grand dividend, (having firſt

put a point under it) and put it on the right hand of the Remainder for a new dividual as before, *&c.*

Observing this general Rule in all kind of Division, first to seek how often the divisor is contained in the dividual; then (having put the answer in the quotient) multiply the Divisor thereby, and Subtract the Product from the dividual. An Example or two will make the Rule plain. Let it be Required to divide 2184 by 6, I dispose of the Numbers given as is before directed, and as you see in the margent, in order to the work, then (because 6 the divisor is more then 2 the first Figure of the dividend) I put a point under 1 the second Figure, which make the 21 for the Dividual, then do I ask how often 6 the divisor, is contained in 21 and because I cannot have it more then 3 times, I put 3 in the Quotient, and thereby do I multiply the divisor 6 and the product is 18, which I set in order under the dividual, and Subtract it therefrom, and the Remainder (3) I place in order under the line as you see in the Margent.

6) 2184 (

6) 2184 (3
18

3

Then do I make a point under the next

Figure

Figure of the dividend being 8, and draw it down, placing it before the Remainder 3, So have I 38 for a new dividual, then do I seek how often 6 is contained in 38, and because I cannot have more than 6 times, I put 6 in the quotient, and thereby do I multiply the divisor 6, and the product (36) I put under the dividual (38) and Subtract it therefrom, and the remainder 2 I put under the line as you see in the Margent.

```
6) 2184 (36
   18
   ---
   38
   36
   ---
    2
```

Then do I put a point under the next (and last) Figure of the dividend (being 4) and draw it down to the remainder 2, and puting it on the Right hand thereof it maketh 24 for a new dividual; then I seek how often 6 is contained in 24, and the Answer is 4, which I put in the quotient, and multiply the divisor (6) thereby and the product (24) I put under the dividual, and Subtract it from it, and the Remainder is 0, and thus the work is finished, and I find the quotient to be 364, that is, 6 is contained in 2184 just 364 times, or 2184

```
6) 2184 (364
   18
   ---
   38
   36
   ---
    24
    24
   ---
    00
```

being divided into 6 equal parts, 364 is one of those parts.

If it were Required to divide 2646 by 7 or into 7 equal parts, the quotient would be found to be 378, as by the following operation appeareth.

```
7) 2646 (378
   21
   ---
    54
    49
    --
     56
     56
     --
      00
```

So if it were Required to divide 946 by 8, the Quotient will be found to be 118 and 2 Remaining after Division is ended. The work followeth.

```
8) 946 (118
   8
   ---
    14
     8
     --
      66
      64
      --
      (2)
```

Many

Many times the dividend cannot exactly be divided by the diviſor, but ſomething will Remain, as in the laſt Example; where 946 was given to be divided by 8; the quotient was 118 and there Remaineth 2 after the diviſion is ended; Now what is to be done in this caſe with the Remainder, the Learner ſhall be taught when we come to treat of the Reducing, or Reduction of Fractions.

And here Note, that if after your Diviſion is ended, any thing do Remain, it mu't be leſſer then your diviſor, for otherwiſe your work is not Rightly performed.

Other Examples are ſuch as follow.

8)73464(9183
72
14
8
66
64
24
24
(0)

9)13758(1528
9
47
45
25
18
78
72
(6)

5. But if the diviſor conſiſteth of more place then one, then chooſe ſo many Figures from the left ſide of the dividend for a dividual, as there are Figures in the diviſor, and put a point under the fartheſt Figure of that dividual to the Right hand, and ſeek how often the firſt Figure on the Left ſide of the diviſor, is contained in the firſt Figure on the Left ſide of the dividual, and place the Anſwer in the quotient, and thereby multiply your diviſor, placing the product under your dividual, and Subtract it therefrom, placing the Remainder below the line; then put a point under the next Figure in the dividend, and draw it down to the ſaid Remainder, and annex it on the Right ſide thereof, which makes a new dividual, and proceed as before, *&c.*

And if it ſo happen that after you have choſen your firſt dividual (as is before directed) you find it to be leſſer then the diviſor, then put a point under a Figure more, nearer to the Right hand, and ſeek how often the firſt Figure on the Left ſide of the diviſor, is contained in the two firſt Figures on the Left ſide of the dividual, and place the anſwer in the quotient, by which multiply the diviſor and place the product thereof in order under the dividual, and Subtract it therefrom, and proceed *&c.*

Always

Alwayes remembring, that (in all the cases of division) if after you have multiplyed your divisor by the Figure last placed in the quotient, the product be greater then the dividual, then you must cansel that Figure in the quotient, and instead thereof put a Figure lesser by a unit (or one) and multiply the divisor thereby, and if still the product be greater then the dividual, make the Figure in the quotient yet lesser by a unit, and thus do untill your product be lesser then the dividual, or at the most equal thereto, and then make Subtraction, *&c.*

So if you would divide 9464 by 24, the quotient will be found to be 394, I first put down the given *Numbers* as before is directed, now because my divisor consisteth of two Figures, I therefore put a point under the second Figure from the Left hand in my dividend, which here is under four, wherefore I seek how often two the first figure (on the Left side of the divisor) is contained in nine (the like first in the dividual) the answer is four, which I put in the quotient and thereby multiply all the divisor and find the product to be ninety six, which is greater than the dividual ninety four, wherefore I cancel the four in the

```
          3
24)9464(4
   72
   --
   22
```

quotient, and inſtead thereof I put three (a unit leſſer) and by it I multiply the diviſor twenty four, and the product is ſeventy two, which I Subtract from ninety four the dividual, and the Remainder is twenty two, then do I make a point under the next Figure ſix in the dividend, and draw it down and place it on the Right ſide of the Remainder twenty two, and it makes 226 for a new dividual, now becauſe the dividual 226 conſiſteth of a Figure more then the diviſor, therefore I ſeek how often 2 (the firſt Figure of the diviſor) is contained in 22 (the two firſt of the dividual) I ſay nine times, wherefore I put nine in the quotient, and thereby multiply the diviſor 24, the product 216 I place under the dividual 226, and Subtract it from it, and there Remaineth 10.

```
24) 9464 (39
    72
    ---
    226
    216
    ---
     10
```

Then I go on and make a point under the next and laſt Figure (4) in the dividend, and pull it down to the Remainder 10, and it maketh 104, for a new dividual, which is alſo a Figure more then the diviſor, and therefore I ſeek how often two is contained in ten, I anſwer five, but multiplying my diviſor by five, the product is 120, which

is

is greater then the divisor, and therefore I make it but four, and by it multiply the divisor, and the product is 96 which being placed under, and Subtracted from the Dividual, there Remaineth 8, and thus the whole work of this Division is ended, and I find that 9464 divided by 24, or into 24 equal parts the Quotient, or one of those equal parts, is found to be 394 as was said before, and there Remaineth 8.

```
24) 9464 (394
    72
    ---
    226
    216
    ---
    104
     96
    ---
      (8)
```

Another Example may be this, let there be Required the quotient of 1183653 divided by 385, first I dispose of the *Numbers* in order to their dividing, and because 118 the three first Figures of the dividend is lesser than the divisor, I therefore make a point under the fourth Figure, which is 3, and seek how often 3 is contained in 11? the answer is (3) which I put in the quotient, and thereby multiply the divisor, and the Product is 1155 which I subtract

```
385) 1183653 (3
     1155
     ----
       28
```

tract from the dividual 1188 and there Remaineth 28. Then (as before) I pull down the next Figure, which is six, and place it before the Remainder 28, so have I 286 for a new dividual, and because it hath no more Figures than the divisor I seek how often 3 (the first Figure in the divisor) is contained in 2 (the first Figure of the dividual) and the answer is 0, for a greater Number cannot be contained in a lesser, wherefore I put 0 in the the quotient and thereby (according to Rule) I should multiply my Divisor, but if I do the product will be 0, and 0 Subtracted from the dividual 286 the remainder is the same; wherefore I pull down the next figure (5) from the dividend and put it before the said Remainder 286 so have I 2865 for a new dividual, and because it consisteth of four places (*viz.*) a place more than the divisor, I seek how often 3 (the first Figure of the divisor) is contained in 28 (the two first of the dividual)

```
385) 1183653 (30
     1155
     ----
      286
```

```
385)1183653(307
    1155
    ----
    2865
    2695
    ----
     170
```

dual) and I say there is 9 times 3 in 28 but multiplying my whole divisor (385) therby I find the product to be 3465, which is greater than the dividual 2865, wherefore I choose eight which is lesser by a Unit than nine, and thereby I mult ply my divisor 385, and the product is 3080, which still is greater then the said dividual, wherefore I choose another Number yet a Unit lesser, *viz.* 7; and having multiplyed my divisor thereby the product is 2695 lesser than the dividual 2865, wherefore I put seven in the quotient, and Subtract 2695 from the dividual 2865, and there remains 170, then I pull down the last figure 3 in the dividend and place it before the said Remainder 170, and it makes 1703 for a new dividual, then (for the reason abovsaid) I seek how often three is contained in 17, the answer is 5, but multiplying the divisor thereby, the product is 1925 greater than the dividual, wherefore I say it will bear four, a Unit lesser, and by it I multiply the divisor 385, and the product is 1540, which is lesser than the dividual

```
385) 1183653 (3074
     1155
     ----
      2865
      2695
      ----
       1703
       1540
       ----
        163
```

dual, and therefore I put four in the quotient, and Subtract the ſaid product from the dividual, and there Remaineth 163, and thus the work is finiſhed, and I find that 1183653 being divided by 385, or into 385 equal ſhares or parts, the Quotient or one of thoſe parts is 3074, and beſides there is 163 Remaining.

And thus the Learner being well verſed in the method of the foregoing Examples, he may be ſufficiently quallified for the dividing of any greater ſumme or number into as many parts as he pleaſeth, that is, he may underſtand the method of dividing by a Diviſor conſiſting of 4 or 5 or 6 or any greater number of places, the method being the ſame with the foregoing Examples in every Reſpect.

Other

Other Examples of Diviſion.

27986) 835684790 (29860
55972
275964
251874
240907
223888
170199
167916
Remains (22830)

196374) 473986018 (2413
392748
812380
785496
268841
196374
724678
589122
Remains (135556)

So if you divide 47386473 by 58736 you will find the Quotient to be 806, and 45257 will Remain after the work is ended.

In like manner if you would Divide 3846739204 by 483064, the Quotient will be 7963 and the Remainder after Division will be 100572.

Compendiums in Division.

1. IF any given Number be to be Divided by another Number that hath Cyphers prefixed on the Right side thereof, (omitting the Cyphers) you may cut off so many Figures from the Right hand of the Dividend, as there are Cyphers before the Divisor, and let the Remaining numbers in the Dividend, be divided by the Remaining number or numbers in the Divisor; observing this Caution, that if after your Division is ended, any thing Remain; you are to prefix the *number* or *numbers* that were cut off from the *Dividend* before the *Numbers* Remaining; and such new found

Et si Divisor adjunctos sibi habeat Circulo ad dextram, omissis circulis & abscissis totidem ultimis figuris dividendi, in numeris Reliquis fiat divisio in fine autem divisionis Restituendi sunt tum omissi circuli, tum figuræ abscissæ. *Ought. Cla. Math. Cap.* 5. 3.

found *Number* ſhall be the Remainder. As for Example; Let it be Required to divide 46658 by 400 now becauſe there are two cyphers before the diviſor, I cut off as many Figures from before the *Dividend*, *viz.* 58, ſo that then there will Remain only 466 to be *divided* by 4, and the Quotient will be 116, and there will Remain 2, before which I prefix the two Figures (58) which were cut off from the *Dividend* and it makes 258 for the True Remainder, ſo that I conclude 46658 *divided* by 400 the Quotient will be 116, and 258 Remaineth after the work is ended; as by the work in the Margent.

```
4|00) 466|58 (116
      4
      ---
       6
       4
      ---
       26
       24
      ---
       258
```

2. And hence it followeth that if the diviſor be (1) or a unite with Cyphers prefixed, you may cut off ſo many figures from before the dividend, as there are Cyphers in the diviſor, and then the figure or figures that are on the left hand, will be the Quotient, and thoſe on the right hand will be the Re-

Diviſurus quemcunq; numerum per 10, Aufer ex dextera parte unicam, eamque primam figuram; Reliquæ enim figuræ productum oſtendunt; ablatum Reſiduum, &c. Gem. Friſ. Arith. par. 1.

Remainder, after the Diviſion is ended: as thus, if 45783 were to be divided by 10, I cut off the laſt figure (3) with a daſh thus (4578|3) and the work is done, and the quotient is 4578 (the number on the left hand of the daſh,) and the Remainder is 3 (on the right hand;) In like manner if the ſame Number 45783 were to be divided by 100, I cut off 2 figures from the end thus (457|83) and the quotient is 457, and the remainder 83. And if I were to divide the ſame by 1000, I cut off 3 figures from the end thus (45|783) and the quotient is 45, and 783 the Remainder, *&c.*

6. The General effect of Diviſion is contained in the definition of the ſame, (that is) by having two unequal numbers given to finde a third number in ſuch proportion to the dividend, as the diviſor hath to unite, or 1, It alſo diſcovers what reaſon, or proportion there is between numbers, ſo if you divide 12 by 4 it quotes 3, which ſhews the reaſon, or proportion of 4 to 12 is triple.

The ſecond effect is by the ſuperficial meaſure or content, and the length of any oblonge, Rectangular paralelogram, or ſquare plane known, to finde out the breadth thereby; or contrariwiſe by having the ſuperficies, and breadth of the ſaid figure, to finde out the length thereof. Alſo by

cies

having the ſolidity and length of a ſolid to find the ſuperficies of the baſe, *& Contra.*

The third effect is, by the contents, Reaſon, price, vallue, buying, ſelling, expences, wages, exchange, intereſt, profit, or loſs of any things (be it Money, Merchandize, or what elſe) to find out the contents, reaſon, price, value, buying, ſelling expence, wages, exchange, intereſt, profit, or loſs, of any one thing of like kinde.

The fourth effect is to aid, to compoſe, and to make other Rules, but principally the Rule of proportion, called the Golden Rule, or Rule of three; and the Reduction of Moneys, weight and meaſure, of one denomination into another, by it alſo fractions are abbreviated by finding a common meaſurer, unto the numerator and denominator, thereby diſcovering commenſurable numbers.

If you Divide the value of any certain quantity by the ſame quantity, the Quotient diſcovers the Rate or value of the Integer, as if eight yards of Cloth coſt 96 ſhillings, here if you divide (96) the value, or price of the given quantity by (8) the ſame quantity, the Quotient will be 12 *s*, which is the value or price of 1 of thoſe yards; *& contra.*

If you divide the value, or price of any unknown quantity, by the value of the Integer,

teger, it gives you in the quotient that unknown quantity, whoſe price is thus divided; as if 12 ſhillings were the value of 1 yard, I would know how many yards are worth 96 ſhillings, here if you divide (96) the price or value of the unknown quantity, by (12) the rate of the Integer, or one yard, the quotient will be 8, which is the number of yards worth 96 ſhillings.

Some Queſtions anſwered by Diviſion may be theſe following.

Queſt. 1. If 22 things coſt 66 ſhillings, what will 1 ſuch like thing coſt? *facit* 3 ſhillings; for if you divide 66 by 22 the Quotient is 3 for the Anſwer; ſo if 36 yards or ells of any thing be bought or ſold for 108 *l.* how much ſhall 1 yard or ell be bought or ſold for? *facit* 3 *l.* for if you divide 108 *l.* by 36 yards the Quotient will be 3 *l.* the price of the Integer.

Queſt. 2. If the expence, charges, or wages of 7 years amounts to 868 *l.* what is the expence, charges, or wages of one year? *facit* 124 *l.* for if you divide 868 (the wages of 7 years,) by 7 (the number of years) the Quotient will be 124 *l.* for the Anſwer, ſee the work.

7)

7) 868 (124
7
16
14
28
28
(0)

Queſt. 3. If the content of a ſuperficial foot be 144 Inches, and the breadth of a board be 9 Inches, how many Inches of that board in length will make ſuch a foot? *facit* 16 Inches; for by dividing 144 (the number of ſquare Inches in a ſquare foot,) by 9 (the Inches in the breadth of the board) the Quotient is 16 for the number of Inches in length of that board, to make a ſuperficial foot.

9) 144 (16 Inches
9
54
54
(0)

Queſt. 3. If the content of an Acre of Ground be 160 ſquare Perches, and the length of a furlong (propounded) be 80 Perches, how many Perches will there go

in

in bredth to make an Acre, *facit* 2 Perches for if you divide 160 (the number of Perches in an Acre) by 80 (the length of the furlong in Perches) the Quotient is 2 Perches; and so many in breadth of that furlong will make an Acre.

80) 160 (2 Perches
160
(0)

Queſt. 5. If there be 893 men to be made up into a battail, the front conſiſts of 47 men, what *Number* muſt there be in the File? *Facit* 19 deep in the File: For if you divide 893 (the *Number* of men) by 47 (the number in front) the Quotient will be 19 the file in depth, the work followeth.

47) 893 (19 *deep in file*
47
423
423
(0)

Queſt.

Queſt. 6. There is a *Table* whoſe Superficial Content is 72 feet, and the breadth of it at the end is 3 feet, now I demand what is the Length of this Table? *Facit* 24 feet long; for if you divide 72 (the content of the Table in feet) by 3 (the bredth of it) the Quotient is 24 feet for the length thereof which was Required. See the operation as followeth.

3) 72 (24
6
—
12
12
—
(0)

The proof of Multiplication and Diviſion.

Multiplication and *Diviſion* Interchangably prove each other; for if you would prove a ſumme in *Diviſion*, whether the operation be Right or no, Multiply the Quotient by the *Diviſor*; and if any thing Remain after the *Diviſion* was ended, add it to the Product, which Product (if your ſumme was Rightly *divided*) will be equal to the *Dividend*; And Contrariwiſe (if you would prove a ſumme in Multiplication, *divide* the *Product* by the *Multipliar*,

and if the work was Rightly performed, the Quotient will be equal to the Multiplicand. See the Example where the work is done and undone; Let 7654 be given to be Multiplyed by 3242, the product will be 24814268 as by the work appeareth.

```
  7654
  3242
 -----
 15308
30616
15308
22962
-------
24814268
-------
```

And then if you *Divide* the said *Product* 24814268 by 3242 the Multipliar, the Quotient will be 7654 equal to the given Multiplicand.

3242)

3242) 24814268 (7654
22694
21202
19452
17506
16210
12968
12968
(0)

In like manner (to prove a Summe or Number in *Division*) If 24814268 were *Divided* by 3242 the Quotient would be found to be 7654; then for proof, if you Multiply 7654 the Quotient by 3242 the *Divisor*, the Product will amount to 24814268, equal to the Dividend.

Or you may prove the last or any other Example in Multiplication thus, *viz.* *Divide* the Product by the Multiplicand, and the Quotient will be equal to the Multipliar see the work.

```
          7654
          3242
        -----
         15308
        30616
       15308
      22962
      -------
7654) 24814268 (3242
      22962
      -----
       18522
       15308
       -----
        32146
        30616
        -----
         15308
         15308
         -----
          (0)
```

From whence ariseth this Corollary, that any operation in *Division* may be proved by *Division*; for if after your *Division* is ended, you divide the *Dividend* by the Quotient, the new Quotient thence ariseing will be equal to the *Divisor* of the first operation; for Tryal whereof let the last Example be again Repeated.

```
3242) 24814268 (7654
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
           (0)
```

For proof whereof divide again 24814268 by the Quotient 7654, and the Quotient thence will be equal to the first *Divisor* 3242 see the work.

```
7654) 24814268 (3242
      22962
      -----
       18522
       15308
       -----
        32146
        30616
        -----
         15308
         15308
         -----
           (0)
```

But in proving *Division* by *Division*, the Learner is to observe this following Caution, that if after his *Division* is ended there be any Remainder, before you go about to prove your work, Subtract that Remainder out of your Dividend, and then work as before, as in the following Example, where it is Required to divide 43876 by 765, the Quotient here is 57 and the Rema nder is 271 ; See the work following.

765) 43876 (57
3825
5626
5355
(271)

Now to prove this work Subtract the Remainder 271 out of the *Dividend* 43876 and there Remaineth 43605 for a new *Dividend* to be *divided* by the former *Quotient* 57, and the *Quotient* thence arising is 765 equal to the given *Divisor*, which proveth the operation to be Right.

43876

43876
271

57) 43605 (765
1 399

370
342

285
285

(0)

Thus have we gone through the four Species of Arithmetick, *viz.* Addition, Subtraction, Multiplication, and Diviſion; upon which all the following Rules and all other operations whatſoever that are poſſible to be wrought by numbers have their Immediate dependance, and by them are Reſolved. Therefore before the Learner make a further ſtep in this Art, let him be well acquainted with what hath been delivered in the foregoing Chapters.

Hæ ſunt igitur quatuor illæ ſpecies arithmeticæ, per quas omnia quæcunque deinceps dicenda ſunt vel quæ per numeros fieri poſsibile eſt, abſolvuntur. Quare eas, quiſquis ei, ante omnia perdiſces. Gem. Friſ. Arith. par. 1.

CHAP. VIII.

Of Reduction.

1. REDUCTION, is that which brings together 2 or more numbers of different denominations, into one denomination; or it serveth to change or alter Numbers, Money, Weight, Measure, or Time, from one Denomination to another; and likewise to abridge fractions to their lowest *Termes*. All which it doth so precisely, that the first *Proportion* Remaineth without the least jot of *Error* or *Wrong* Committed. So that it belongeth as well to *Fractions* as *Integers*, of which in its *proper* place. *Reduction* is generally performed, either by Multiplication or Division; from whence we may gather, that

Hilles Arith. Ch. 13. 152.

2, *Reduction* is either Descending or Ascending.

3. *Reduction* Descending, is when it is Required to *Reduce* a *Sum* or *Number* of a greater Denomination, into a lesser; which

Num-

Number, when it is ſo *reduced*, ſhall be equal in value to the *Number* firſt given in the greater Denomination; as if it were Required to know how many ſhillings, pence or *farthings* are equall in value to a *hundred pounds*? or how many *ounces* are contained in 45 *hundred weight*; or how many *dayes*, *hours*, or *minutes*, there are in 240 *Years*, &c. And this kind of *Reduction* is generally performed by Multiplication.

Wing. Arith. Ch. 7. 2, 3, 4.

4. *Reduction* Aſcending, is when it is Required to *Reduce* or *bring* a *Sum* or *Number* of a ſmaller Denomination into a Greater, which ſhall be equivalent to the given *number*; As ſuppoſe it were Required to find out how many Pence, Shillings or Pounds, are equal in value to 43785 *Farthings*; or how many *Hundreds* are equal to (or in) 3748 *l. pounds*, &c. and this kind of *Reduction* is alwayes performed by *Diviſion*.

5. When any *Sum* or *Number* is given to be *Reduced* into another Denomination, you are to conſider whether it ought to be Reſolved by the Rule Deſcending or Aſcending, *viz.* by Multiplication or Diviſion; If it be to be performed by Multiplication, conſider how many parts of the de-

nomination into which you would Reduce it, are contained in a *Unit* or *Integer* of the given *Number*, and multiply the said given *Number* thereby, and the *Product* thereof will be the Answer to the Question. As if the Question were, in 438 *l. pounds* how many *shillings?* here I consider that in one *pound* are 20 *shillings*, and that the number of *shillings* in 38 *l. pounds* will be 20 times 38 wherefore I multiply 38 *l.* by 20, and that product is 760, and so many shillings are contained in 38 pounds.

But when there is a Denomination, or Denominations between the *Number* given and the *Number* Required, you may (if you please) Reduce it into the next inferior Denomination, and then into the next lower than that, *&c.* untill you have brought it into the denomination Required; As for Example, let it be demanded in 132 *pounds*, how many *Farthings?* First I multiply 132 (the *Number* of pounds given) by 20 to bring it into shillings, and it makes 2643 shillings, then do I Multiply the shillings (2640) by 12, to bring them into pence, and it produceth

132	*pounds*
20	
2640	*shillings*
12	
5280	
2640	
31680	*pence*
4	
126720	*farthings*

ceth 31680, and ſo many pence are contained in 2640 ſhillings, or 132 pounds; then do I Multiply the pence, *viz.* 31680 by 4 to bring them into *Farthings* (becauſe 4 *farthings* is a peny) and I find the *product* thereof to be 126720, and ſo many *farthings* are in equal value to 132 pounds, the work is manifeſt in the Margent.

And if the *number* propounded to be Reduced, is to be divided, or wrought by the Rule Aſcending; conſider how many of the given *numbers* are equal to an Unit or *Integer* in that denomination to which you would *reduce* your given *number*, and make that your *diviſor*, and the given *number* your *dividend*; and the Quotient thence *ariſing* will be the *number* ſought or *required*; As for Example, Let it be *Required* to Reduce 2640 *ſhillings* into *pounds*; here I *conſider* that 20 *ſhillings* are equal to one *pound*, wherefore I divide 2640 (the given *number*) by 20, and the Quotient is 132 and ſo many *pounds* are contained in 2640 *ſhillings*. In Reduction deſcending and aſcending the Learner is adviſed to take particular notice of the Tables delivered in the ſecond

l.
20)2640(132
2
—
6
6
—
4
4
—
(0)

Chapter of this Book, where he may be informed what *Multipliars*, or *Diviſors* to make uſe of in the *reducing* of any *number* to any other denomination whatſoever, Eſpecially *Engliſh* Moneys, Weights, Meaſures, Time and Motion, but in this place it is not convenient to meddle with *Forreign* Coynes, Weights or *Meaſures.*

But if in Reduction Aſcending it happen that there is a denomination, or denominations between the *number* given and the *number* Required, then you may Reduce your *number* given into the next *Superiour* denomination, and when it is ſo Reduced, bring it into the next above that, and ſo on until you have brought it into the Denomination *Required.* As for Example,

Let it be demanded in 126720 *farthings*, how many *pounds?* Firſt I divide my given *number* (being *farthings*) by 4, to bring them into pence, (becauſe 4 *farthings* make one peny) and they are 31680 pence, then I divide 31680 *pence* by 12, and the Quotient giveth 2640 *ſhillings*, and then I divide 2640 ſhillings by 20, and the Quotient giveth 132 pounds, which are equal in value to 126720 *farthings.* See the whole work as it followeth.

12)

```
                12)      20)      l.
4) 126720 (31680 (2641|0 (132
   .....    ....    ...
   12       24       2
   ---      ---      --
    6       76       6
    4       72       6
   ---      ---      --
   27       48       4
   24       48
   ---      ---
   32       (0)
   32
   ---
   (0)
```

6. When the *number* given to be Reduced, consisteth of divers denominations, as *pounds*, *shillings*, *pence*, and *farthings*; or of *hundreds*, *quarters*, *pounds*, and *ounces*, &c. then you are to Reduce the highest (or greatest) denomination into the next *Inferiour*, and add thereunto the *number* standing in that denomination which your greatest or highest *number* is Reduced to; then Reduce that *Sum* into the next *Inferiour* denomination, adding thereto the *number* standing in that denomination; do so until you have brought the *number* given into the denomination proposed. As if it were *Required* to Reduce 48 *l.* 13 *s.* 10 *d.* into *pence*, first I bring 48 *l.* into *shillings*, by

by multiplying it by 20 and the *product* is 960 *ſhillings*, to which I add the 13 *ſhillings* and they make 973, then I multiply 973 by 12, to bring the *ſhillings* into *pence*, and they make 11676 *pence*, to which I add the 10 *pence*, and they make 11686 *pence* for the Anſwer, ſee the whole work done

	l.	s.	d.
	48	13	10
	20		
	960	*ſhillings*	
Add	13		
Sum	973	*ſhillings*	
	12		
	1946		
	973		
	11676	*pence*	
Add	10		
Sum	11686	*pence*	

7. If (in Reduction Aſcending) after Diviſion is ended, any thing Remain, ſuch Remainder is of the ſame denomination with the Dividend.

Examples in Reduction of Coyn.

Queſt. 1. In 438 *l.* how many *ſhillings*?

Facit

Facit 8760 *ſhillings*, for Multiplying 438 by twenty, the *Product* amounteth to ſo much.

	l.	
	438	
	20	
Facit	8760	*ſhillings.*

Queſt. 2. In 467 *l.* how many *pence*? Firſt multiply the given *number* of *pounds* 467 by 20, to bring it into ſhillings, and it makes 9340 *ſhillings*, then multiply the ſhillings by 12 and it produceth 112080 *pence*, thus

	467	*pounds*
	20	
	9340	*ſhillings*
	12	
	18680	
	9340	
Facit	112080	*pence*

Or it may be Reſolved thus, *viz.* multiply the given *number* of pounds 467, by 240 the *Number* of *Pence* in a *Pound*, and

and the Product is the same, *viz.* 112080 *pence*,

467 *pounds*
240

18680
934

Facit 112080 *pence*

Quest. 3. In 5673, *l.* how many *Farthings?* First Multiply the given *Number* by 20 to bring it into *shillings*, and it produceth 113460, then multiply that *product* by 12 to bring it into *pence*, and it produceth 1361520; then lastly, Multiply the *pence* by 4, and it produceth 5446080 *farthings*. See the operation.

5673 *pounds*
20

113460 *shill.*
12

226920
113460

1361520 *pence*
4

facit 5446080 *farth.*

Or

Or this Queſtion might have been thus Reſolved, *viz.* Mu'tiply 5673 the given *Number* of *pounds* by 960 the *Number* of *farthings* in a *pound*, and it produceth the ſame Effect.

	5673	*pounds*	20	*ſhillings*
	960		12	
	340380		240	*pence*
	51057		4	
Facit	5446080	*farthings*	960	*farth.*

Otherwiſe thus, Firſt bring the given *Number* 5673 *l.* into *ſhillings*, and multiply the *ſhillings* by 48, the *Number* of *Farthings* in a *ſhilling*, and the ſame effect is thereby likewiſe produced, *viz.*

	5673	*pounds*	12	*pence*
	20		4	
	113460	*ſhillings*	48	*farthings.*
	48			
	907680			
	453840			
Facit	5446080	*farthings*		

Theſe various wayes of Operating are expreſſed to Inform the Judgment of the Lear-

Learner with the Reason of the Rule; more wayes may be shewn, but these are sufficient even for the meanest capacities.

Quest. 4. In 458 *l.* 16 *s.* 07 *d.* 3 *qrs.* how many *farthings?* To Resolve this question consider the 6 Rule of this Chapter, and work as you are there directed, and you will find the aforesaid given *number* to amount to 440479 *farthings*, viz.

	l.	s.	d.	qrs.
	458	—16	—07	—3
	20			
	9160	*shillings*		
Add	16			
Sum	9176	*shillings*		
	12			
	18352			
	9176			
	110112	*pence*		
Add	07			
Sum	110119	*pence*		
	4			
	440476	*farthings*		
Add	3			
Sum	440479	*farthings*		

This

This laſt Queſtion (or any other of this kind, *viz.* where the *number* given to be Reduced conſiſteth of ſeveral denominations) may be more concisely Reſolved thus *viz.* when you multiply the pounds by 20 to bring them into ſhillings, to the *product* of the firſt *Figure*, add the *Figure* ſtanding in the place of Units in the denomination of ſhillings, but becauſe the firſt *Figure* in the *Multipliar* is (0) I ſay 0 times 8 is nothing, but 6 is 6, which I put down for the firſt *Figure* in the *product*, then becauſe this *Multipliar* is 0, I go on no further with it, for if I ſhould, the whole product would be 0, but proceed, and when I come to multiply by the ſecond *Figure* in the *multipliar*, to the *Product* of it, and the firſt *Figure* of the *Multiplicand*, I add the *Figure* ſtanding in the place of tens in the denomination of ſhillings, which is (1) ſaying 2 times 8 is 16 and (the ſaid *Figure*) 1 is 17, then I ſet down 7 and carry a Unit to the *product* of the next *Figure* as is directed in the 5 Rule of the 6 Chapter foregoing; and finiſh the work. So that you now have the whole product and ſum of ſhillings at one operation; and when you multiply the *ſhillings* by 12 to bring them into pence, after the ſame manner add to the product, the *number* ſtanding in the denomination of

pence

pence, and ſo when you multiply the *pence* by four to bring them into *Farthings*, add to the *product* the *number* ſtanding under the denomination of *Farthings*, ſee the laſt Queſtion thus wrought.

l.	s.	d.	qrs.
458	—16	—07	—3
20			
9176 *ſhillings*			
12			
18359			
9176			
110119 *pence*			
4			

facit 440479 *farthings*

After the method laſt preſcribed (which if Rightly conſidered, differeth not any thing from the ſixth Rule of this Chapter) are all the following Examples that are of the ſame Nature wrought and Reſolved.

Queſt. 5. In 4375866 *farthings* I demand how many *Pounds*, *Shillings*, *Pence* and *Farthings*.

To Reſolve this Queſtion, firſt I divide the given *number* of *Farthings* by 4, and the Quotient is 1093966 *pence*, and there Re-

Remaineth 2 after the Division is ended, which (by the Seventh Rule foregoing) is two *Farthings*; then I divide 1093966 *pence* by 12, and the quotient is 91163 *shillings*, and there Remaineth 10 after division which by the said 7th Rule is so many *Pence*, *viz.* 10 *d.* then I divide 91163 *shillings* by 20, and the Quotient is 4558 *l.* and there Remaineth 3 *shillings*; so the work is finished, and I find that in 4375866 *farthings* there are 4558 *l.* 03 *s.* 10 *d.* 2 *qrs.* See the Operation.

```
                 12)        2|0        l.
4) 4375866 (1093966 (9116|3 (4558
   ...:....   .....   ....
   4          108        8
   ---        ---        ---
    37         13        11
    36         12        10
    ---        ---       ---
     15        19        11
     12        12        10
     ---       ---       ---
      38        76        16
      36        72        16
      ---       ---       ---
       26        46       (03)
       24        36
       ---       ---
        26      (10)
        24
        ---
       (2)
```

	l.	s.	d.	qrs.
Facit	4558	03	10	2

Quest.

Queſt. 6. In 4386 *l.* I demand how many Groats?

To Reſolve this Queſtion, I Reduce the given *number* of pounds into ſhillings, and they are 87720 ſhillings, now I conſider that in a ſhilling are 3 Groats, therefore I multiply the ſhillings by 3, and it produceth 263160 Groats; See the work.

4386 *pounds*
20
87720 *ſhillings*
3
Facit 263160 *groats*

This Queſtion might have been otherwayes Reſolved thus, *viz.* conſidering that in a pound (or 20 ſhillings) there are three times 20 Groats which makes 60, by which I multiply the *number* of pounds given, and it produceth the ſame effect at one operation as followeth.

4386 *pounds*	20
60 *groats in* 20 *s.*	3
Facit 263160 *groats in* 4386 *l.*	60

Queſt.

Quest. 7. In 43758 three pences I desire to know many pounds?

To Resolve this (many such like) Question, first I divide my given *number* of 3 pences by 4 because 4 three pences are in a shilling, and the Quotient is 10939 shillings; and there Remaineth 2 after division is ended, which is 2 three pences (by the seventh Rule of this Chapter) which are equal in value to 6 *d.* then I divide 10939 shillings by 20, and the quote giveth 546 *l.* and 19 shillings Remain; so that I conclude in 43758 pieces of three pence *per* piece, there are 546 *l.* 19 *s.* 06 *d.* as by the work appeareth.

```
                 1|0)      l.    s.   d.
4) 43758 (10939 (546—19—06
   4        10
   ——       ——
    37       9
    36       8
    ——       ——
     15      13
     12      12
     ——      ——
      38      19 shillings
      36
      ——
      (2) three pences or 6 d.
```

This question might have been otherwise Re-

This Question might have been otherwise Resolved thus, *viz.* first multiply the given *number* of three pences 43758, by 3 the *number* of pence in three pence, and the product *viz.* 131274 is the *number* of pence equal to the given *number* of three pences, which *number* of pence may be brought into pounds by dividing by 12 and by 20, and the quotient you will find to be equal to the former work, *viz.* 546 *l.* 19 *s.* 06 *d.*

```
      43758
          3
      ------   2|0)      l.   s.   d.
12) 131274 (109319 (546—19—06
     .....    ...
     12       10
     ---      ---
     112       9
     108       8
     ---      ---
      47      13
      36      12
     ---      ---
     114 rem.(19) shillings
     108
     ---
Remains (6) pence
```

Or thus, divide the given *number* of 3 pences by the *number* of 3 pences in 1 *l.* or 20 shillings (which you will find to be 8 if you multiply 20 *s.* by 4, the *number* of

thr

three pences in a shilling) and you will find the quote to be 546 l. as before, and a Remainder of 78 three pences, and if you divide those 78 three pences by 4, you will find the quote to be 19 *s.* and 2 three pences Remain, which are equal to 6 *d.*

```
                    l.    s.   d.
8|0) 4375|8 (546—19—06          20
     ...                         4
     40                         ——
     ——                         80
      37
      32
      ——
       55
       48
       ——      s.
     4) 78 (19
        ..
        4
        ——
        38
        36
        ——
         2 three pences or 6 d.
```

Quest. 8. In 4785 *l.* 13 *s.* how many pieces of 13*d.* $\frac{1}{2}$ *per piece?*

This Question cannot be Resolved by Reduction, descending, or ascending, absolutely, (because 13 *d.* $\frac{1}{2}$ is no even part of a pound) but rather by them both Joyntly viz. by Multiplication and Division; for if

you bring the number given into half pence, and divide the half pence by the half pence in 13 *d.* $\frac{1}{2}$ *viz.* 27, the quotient will be the Answer; for having brought 4785 *l.* 13 *s.* into half pence, I find it makes 2297112, which I divide by 27, because there are so many half pence in 13 *d.* $\frac{1}{2}$ and the quote gives 85078 pieces of 13 *d.* $\frac{1}{2}$ and 6 half-pence Remain over and above, observe the work following.

l.	s.		d.	
4785	—13		13 $\frac{1}{2}$	
20			2	
95713	*shillings*		27	*half pence*
24	*half-pence in a shilling.*			
382852				
191426				
2297112	*half pence in the given number.*			

d.

27) 2297112 (85078 *pieces of* 13 $\frac{1}{2}$

216

137
135

211
189

222
216

Remains (6) *half-pence.*

It would have produced the ſame anſwer if you had Reduced your given number into farthings, and divided by the farthings in 13 *d.* $\frac{1}{2}$ *viz.* 54, (for always the dividend and the Diviſor muſt be of one denomination) and then you would have had a Remainder of 12 farthings which are equal in vallue to the former Remainder of 6 half-pence.

Queſt. 9. In 540 Dollars at 4 s. 4 d. *per* dollar, how many pounds *ſterling*.

Firſt bring your given number of Dollars into Pence, and then your pence into Pounds according to the former directions. Thus in 4 *s.* 4 *d.* (*viz.* a dollar) you will find 52 pence, by which multiply 540 dollars, and it produceth 28080 pence, which if you divide by 240 (the pence in one pound) the quotient will give you 117 *l.* which are equal in value to 540 dollars at 4 *s.* 4 *d.* *per* dollar; obſerve the operation.

```
                                  s.  d.
      540                         4—4
       52                        12
     ----                        --
     1080                        52 pence
    2700
    ------  l.
24|0) 2808|0(117
      ...
      24
     ---
      40
      24
     ---
      168
      168
     ---
      (0)
```

The foregoing queſtion might have been otherwiſe wrought, thus, *viz.* Multiply your given number of dollars by 13 the number of groats in a dollar, or 4 s. 4 d. and it produceth 7020 groates, which divide by 60 (the groats in one pound or twenty ſhillings) and the quote is 117 *l.* as before.

540

	s.	d.
540	4	—4
13	3	
1,620	13 *groates*	
540		

610) 702|0 (117

6

10

6

42

42

(0)

Queſt. 10. In 547386 pieces of 4 *d.* $\frac{1}{2}$ *per* piece, I demand how many Pounds, Shillings, and Pence.

Firſt bring your given number of four pence half penies all into half pence, which you will do if you multiply by 9 the number of half-pence in 4 *d.* $\frac{1}{2}$, and the product is 4926474 half-pence, which are brought into pounds if you divide them by 24 (the half-pence in a ſhilling) and 20 (the ſhillings in a pound, and it makes 10263 *l.* 09 *s.* 9 *d.* as by the work.

```
                                          d.
                                          4½
      547386                              2
           9                              ——
     ———————  2|0)          l.           9 half-pence
24) 4926474 (20526|9 (10263
    48        2
    ——        ——
     126       05
     120        4
     ——        ——
      64       12                      l.    s.  d.
      48       12          facit 10263—09—9
      ——       ——
      167       6
      144       6
      ——       ——
       234 rem.(09)shillings.
       216
       ——
Remains (18) half-pence or 9 d.
```

Quest. 11. In 4386 *l.* I demand how many pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each an equal Number; that is to say, what Number of Six-pences, Groats, and two Pences, will make up 4386 *l.* and the Number of each equal.

The way to Resolve questions of this nature is to add the several pieces (into which the given Number is to be brought) into one summe and to Reduce the given Number

ber into the ſame *denomination* with their Sum, and to divide the ſaid given Number (ſo Reduced) by their Sum, and the Quotient will give you the exact number of each piece. And after the ſame method will we proceed to Reſolve the preſent Queſtion, *viz.*

l.		d.
4386		6
240	*pence*	4
		2
175440	*Sum*	12 *pence*
8772		

12) 1052640 (87720
96
92
84
86
84
24
24
(0)

d. d. d.
facit 87720 *pieces of* 6—4—2

So that I conclude by the operation that 87720 ſix-pences, and 87720 groats, and 87720 two-pences are Juſt as much as, (or equal to) 4386 *l.* or if you admit of 5 *s.* to

be thus divided, it is equal to 5 ſix pences, and 5 four pences or groats, and 5 two pences. *For if two Right lines (or two Numbers) be given, and one of them be divided into as many Parts, or Segments as you pleaſe, the Rectangle, (or Product) comprehended under the two whole Right lines, (or Numbers given) ſhall be equal to all the Rectangles (or Products) contained under the whole line (or Number) and the ſeveral Segments, (or Parts) into which the other line (or Number) is divided, Eucl.* 2. 1.

Another Queſtion of the ſame Nature with the laſt may be this following, *viz.*

Queſt. 12. A Merchant is deſirous to Change 148 *l.* into pieces of 13 *d.* $\frac{1}{2}$, of 12 *d.* of 9 *d.* of 6 *d.* and of 4 *d.*; and he will have of each ſort an equal Number of pieces, I deſire to know the Number?

Do as you were taught in the laſt queſtion, *viz.* add the ſeveral pieces together, and Reduce it into half pence, then Reduce the ſumme to be changed, *viz.* 148 *l.* into the ſame denomination, and divide the greater by the leſſer, and in the Quotient you will find the Anſwer, *viz.* 798 is the Number of each of the pieces Required and 18 doth Remain, as by the following work appeareth.

148

l.		d.	
148		13 1/2	
240	*pence in a* l.	12	
		9	
5920		6	
296		4	
35520	*pence in* 148 l.	*Sum* 44 1/2	
2		2	
71040	*half-pence*	89	*half-pence*

89) 71040 (798 *pieces of each sort*

623

874
801

730
712

Rem. (18) *half-pence.*

The truth of the 2 foregoing operations will thus be proved, *viz.* mult ply the Answer by the parts, or pieces into which the given Number was Reduced, and having added the several products together, If the r summe be equal to the given Number, the Answer is Right, other wise not.

So the Answer to the 11 Question was 87720, which is proved as followeth, *viz.*

		l.
87720	*Six-pences make*	2193
	Four-pences make	1462
	Two-pences make	731
	The total Sum of them	4386

which was the Sum given to be Changed.

The Answer to the 12th question was 798, and 18 half-pence Remained after the work was ended, now the truth of the work may be proved as the former was, *viz.*

	d.	l.	s.	d.
798	*Pieces of* $13\frac{1}{2}$ *make*	44	17	09
	Pieces of 12 *make*	39	18	00
	Pieces of 9 *make*	29	18	06
	Pieces of 6 *make*	19	19	00
	Pieces of 4 *make*	13	06	00
and 18 *half-pence or* 9 d. *rem.*		00	00	09
The total Sum of them		148	00	00

which Total Sum is equal to the Number that was first given to be changed, and therefore the operation was Rightly performed.

Reduction

Reduction of Troy weight.

We come now to give the Learner ſome Examples in *Troy weight*, wherein we ſhall be brief, having given ſo large a Taſte of *Reduction* in the foregoing Examples of Coyn, and now the Learner muſt be mindfull of the Table of *Troy weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures ſtanding in the ſeveral denominations, according to the direction given in the 6 Rule of this Chapter, and you will find the Product to be 2780013 Grains, which is the Number Required, or Anſwer to the Queſtion.

l.	*oz.*	*p.w.*	*gr.*
482	07	13	21
12			
971			
482			
5791 *ounces*			
20			
115833 *peny weight*			
24			
463333			
231668			
Facit 2780013 *grains*			

Queſt. 14. In 2780013 *grains* I demand how many pounds, ounces, peny weights, and grains?

This is but the foregoing queſtion Inverted, and is Reſolved by dividing by 24, by 20, and by 12, and the Anſwer is 482*l.* 07*oz.* 13 *p.w.* 21*gr.*

24)

```
                 2|0)      12)    l.
24) 2780013 (1158313 (5791 (482
    ......     ....     ...
    24         10       48
    ---        ---      ---
     38         15       99
     24         14       96
    ---        ---      ---
    140         18       31
    120         18       24
    ---        ---      ---
    200         3  Rem. (7) ounces
    192         2
    ---        ---
     81 Rem. (13) peny weight
     72
     ---
      93                    l.   oz.  p.w.  gr.
      72          facit   482—07—-13—-21
     ---
Remains (21) graines
```

Queſt. 15. A Merchant ſent to a Goldſmith 16 Ingots of Silver, each containing in weight 2 *l.* 4 *oz.* and ordered it to be made into Bowles of 2 *l.* 8 *oz. per* bowl, and Tankards of 1 *l.* 6 *oz. per piece*, and Salts of 10 *oz.* 10 *p. w. per Salt*, and Spoons of 1 *oz.* 18 *p.w. per Spoon*; of each an equal Number I deſire to know how many of each ſort he muſt make?

This Queſtion is of the ſame Nature with the 11 and 12 Queſtions foregoing, and

and may be anſwered after the ſame method *viz.* Firſt add the weight of the ſeveral veſſels (into which the ſilver is to be made) into one ſum, and Reduce it to one denomination, and they make 1248 *peny weights* then Reduce the weight of the Ingot into the ſame *denomination*, viz. *peny weights*, (and it makes 560 *peny weights*) and multiply them by the Number of Ingots, *viz.* 16, and the product will give you the weight of the 16 Ingots, *viz.* 8960, then divide this Product by the weight of the veſſels, *viz.* 1248, and the quotient giveth you the Anſwer to the queſtion, *viz.* 7, and 224 *p.w.* remaining over and above.

l.	*oz.*
2	4
12	
28	
29	
560	*peny weights*
16	*Ingots*
336	
56	

l.	*oz.*	*p.w.*
2	08	00
1	06	00
0	10	10
0	01	18
Sum 5	02	08
12		
62		
20		
1248	*peny weights*	

1248) 8960 (7 *veſſels of each*
8736

Rem. (224) *peny weight*

The

The Proof of the work is as followeth, Viz.

		l.	*oz.*	*p.w.*		*l.*	*oz.*	*p.w.*
7	*Bowles of*	2	08	00	*per bowl is*	18	08	00
	Tank. of	1	06	00	*per tank is*	10	06	00
	Salts of	0	10	10	*per ſalt is*	06	01	10
	Spoons of	0	01	18	*per ſpoon is*	01	00	06
	224 *peny weight Remaining is*					00	11	04
	Total Sum					37	03	00

So that you ſee the Sum of the weights of each veſſel together with the Remainder is 37 *l.* 03 *oz.* which is equal to the weight of the 16 Ingots delivered.

Reduction of Averdupois Weight.

In Reducing *Averdupois weight,* the Learner muſt have Recourſe to the Table of *Averdupois weight* delivered in the ſecond Chapter foregoing.

Queſt. 16. In 47 *C.* 1 *qrs.* 20 *l.* how many ounces?

Multiply by 4 by 28 and by 16, and the laſt product will be the Anſwer, *viz.* 84990 ounces.

C.	*qrs.*	*l.*
47	1	20

4

189 *quarters*
28

1512
380

5312 *l.*
16

31872
5312

Facit 84992 *ounces*

Queſt. 17. In 84992 ounces I demand how many *C. qrs. l.* and *ounces*?

This is the foregoing Queſtion Inverted, and will be Reſolved if you divide by 16, by 28, and by 4, and the Anſwer 47 *C.* 1 *qrs.* 20 *l.* equal to the given number in the foregoing queſtion.

16)

	28)	4)	*C.*	*qrs.*	*l.*	*oz.*
16) 84992	(5312	(189	(47	— 1 —	20 —	00.

80 28 16

49 251 29
48 224 28

19 272 (1) *quarter.*
16 252

32 (20) *pounds*
32

(0)

Queſt. 18. A Chapman buyeth of a Grocer 4 *C.* 1 *qrs.* 14 *l.* of Pepper, and ordered it to be made up into parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each parcel an equal Number now I would know the Number of each parcel.

This Example is of the ſame nature with the 11. and 12, and 15 queſtions foregoing and after the ſame manner is Reſolved, ſee the operation as followeth.

C.	*qrs.*	*l.*
4	1	14
4		
17		
28		
140		
35		

l.
14
12
8
6
2
42 *pounds*

42) 490 (11
42
70
42
28

Facit 11 *parcels of each*

Rem. (28) *pounds.*

Reduction of Liquid Measure.

Queſt. 19. In 45 *Tun* of wine, how many *Gallons.*

Multiply by 4, and by 63, the product is 11340 Gallons for the Anſwer.

45
4
180
63
540
1080

facit 11340 *gallons*

Queſt.

Queſt. 20. In 34 Rundlets of wine each containing 18 Gallons, I demand how many Hogſheads?

Firſt find how many Gallons is in the 34 Rundlets, which you may do if you multiply 34 by 18 the content of a Rundlet and the Product is 612 Gallons, which you may Reduce into Hogſheads if you divide them by 63, and the Quote will be 9 Hogſheads and 45 Gallons; See the work.

34
18

272
34
---
63) 612 (9 *Hdds.*
567

Remains (45) *gallons.*

Queſt. 21. In 12 Tun, how many Rundlets of 14 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Rundlet, and the Quotient 216 is your Anſwer; See the work following.

12
4
48
63
144
288
14) 3024 (216 *rundl.*
28
22
14
84
84
(0)

Reduction of Long Measure.

Queſt. 22. I demand how many Furlongs, Poles, Inches, and Barley Corns, will Reach from *London* to *York*, it being accounted 151 Miles?

151 *miles*
8

1208 *furlongs*
40

48320 *Poles*
11

48320
48320

531520 *half yards*
18

4252160
531520

9567360 *Inches*
3

facit 28702080 *barley Corns*

Queſt. 23. The Circumference of the Earth (as all other Cireles are) is divided into 360 Degrees, and each degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 miles; now I demand how many miles, Furlongs, perches, yards, feet, and Barley-corns will Reach round the Globe of the Earth?

360 *degrees*
60
21600 *miles*
8
172800 *furlongs*
40
6912000 *Poles or Perches*
11
6912000
6912000
2) 76032000 *half-yards*
(38016000 *yards*, viz. *the* $\frac{1}{2}$ *yards*
3 *divided by* 2.
114048000 *feet*
12
228096000
114048000
1368576000 *Inches*
3

Facit 4105728000 *Barley Corns*; And so many will reach Round the World, the whole being 21600 Miles, so that if any Person were to go Round, and go 15 Miles every Day, he would go the whole Circumference in 1440 Days, which is 3 Years, 11 Months, and 15 Days.

Re-

Reduction of Time.

Queſt. 24. In 28 *years* 24 *weeks* 4 *days* 16 *hours* 30 *minutes*, how many Minutes?

years	*week*	*day*	*hour*	*min.*
28	24	4	16	30

52

60

142

1480 *Weeks*

7

10364 *Dayes*

24

41462

20729

248752 *Houres*

60

1492150 *Minutes*

Note that in Reſolving the laſt queſtion after the method expreſſed there is loſt in every year 30 Hours, for the year conſiſteth of 365 Days and 6 Hours, but by multiplying the years by 52 weeks, which is but 364 days, you looſe 1 day and 6 hours every year, wherefore to find an exact Anſwer, bring the odd weeks, dayes, and hours into hours, and then multiply the years

years by the Number of hours in a year, *viz.* 8766, and to the Product add the hours contained in the odd time, and you have the exact time in hours, which bring into Minutes as before. See the last Question thus Resolved

			weeks days hours
			24—4—16
			7
	days	*hours*	172
28	365	—6	24
8766	24		694
172	1466		345
172	730		4144 *houres*
197	8766 *hours in a year*		
228			
249592 *houres*			
60			
14975550 *Minutes in* 28 *years and* 4144 *hours.*			

So you see that according to the method first used to Resolve this Question the hours contained in the given time are 248752, but according to the last, best, or true method, they are 249592 which exceeds the former by 840 hours.

But for most occasions it will be sufficient to multiply the given years by 365, and to the product add the dayes in the odd time

time if there be any, and then there will be only a loſs of 6 hours in every year, which may be ſupplyed by taking a fourth part of the given years, and adding it to the contained days, and you have your deſire.

Queſt. 25. In 438657540 Minutes, how many years? *Facit* 834 *years*, 4 *dayes* 19 *hours*.

```
                    8766)    years   days   hours
60) 438 6575410 (7310959 (834——4——19
    42          70128
    ——          ——————
     18          29815
     18          26298
     ——          ——————
      6           35179
      6           35064
      ——          ——————days
      57        24) 115 (4
      44              96
      ——              ——
       35        Rem. (19) hours
       30
       ——
        54
        54
        ——
        (0)
```

Queſt. 26. I deſire to know how many hours and minuits it is ſince the birth of our Saviour Jeſus Chriſt, to this preſent year, being accounted 1677 years?

This Queſtion is of the ſame Nature with the 24th foregoing, and after the ſame manner is Reſolved; *viz.* Multiply the given Number of years by 8766, the Product is 14700582 hours, and that by 60 and the product is 882034920 minutes; See the work.

1677 *years.*
8766 *hours in a year.*

10062
10062
11739
13416

14700582 *hours in* 1677 *Y.*
60

882034920 *minuits in* 1677 *Years.*

Note that as Multiplication and Diviſion do Interchangeably prove each other, ſo Reduction Deſcending, and Aſcending, prove each other by Inverting the Queſtion, as the 13 and 14 and likewiſe the 16 and 17 Queſtions foregoing, by Inverſion, do Interchangeably prove each other, the like may be performed for the proof of any Queſtion in Reduction whatſoever?

Thus

Thus far have we diſcourſed concerning ſingle Arithmetick, whoſe Nature, and parts are defined in the ſecond, eighth, ninth, and tenth definitions of the third Chapter of this book, for although Reduction is not reckoned or defined among the parts of ſingle Arithmetick, yet conſidered Abſtractly, it is the proper effect of multiplication and diviſion; and as for the extraction of Roots (which ought to be handled in the next place as parts of ſingle Arithmetick) we ſhall omit, untill the Learner is made acquainted with the Doctrine of Decimals, and Immediately enter upon Comparative Arithmetick.

CHAP. IX.

Of *Comparative Arithmetick, viz.* The Relation of Numbers one to another.

1. COmparative Arithmetick is that which is wrought by Numbers as they are considered to have Relation one to another, and this consists either in quantity, or in quallity.

Boetius Arith. lib. 1. cap. 21.

2. Relation of Numbers in Quantity, is the Reference or Respect, that the Numbers themselves have one to another: where the Terms, or Numbers propounded are always two, the first called the Antecedent and the other the Consequent.

vide Wing: Arith. ch. 34.

3. The Relation of Numbers in quantity, consists in the differences, or in the Rate or Reason that is found betwixt the Termes

Termes propounded the difference of two Numbers, being the Remainder found by Subſtraction, but the Rate or Reaſon betwixt two Numbers is the Quotient of the Antecedent divided by the Conſequent. So 21 and 7 being given the difference betwixt them will be found to be 14, but the rate or reaſon that is betwixt 21 and 7 will be found to be Triple Reaſon, for 21 divided by 7 quotes 3, the reaſon or rate. *Alſted Mathemat. lib. 2. cap. 11. & 12.*

4. The Relation of Numbers in Quality, (otherwiſe called Proportion) is the Reference or Reſpect that the Reaſon of Numbers have one unto another; therefore the Terms given ought to be more than two. Now this Proportion or Reaſon between Numbers relating one to another, is either Arithmetical or Geometrical. *Alſted. Math. lib. 2. cap. 12.*

5. Arithmetical proportion (by ſome called Progreſſion) is when divers Numbers differ one from another by equal Reaſon, that is, have equal differences.

So this Rank of Numbers, 3, 5, 7, 9, 11, 13, 15, 17, differ by equal Reaſon, *viz.* by 2 as you may prove.

6. In a Rank of Numbers that differ by Arithmetical proportion, the Sum of the firſt and laſt term, being multiplyed by

half the number of terms, the Product is the total Sum of all the Terms.

Or if you multiply the Number of the terms by the half Sum of the first and last terms, the Product thereof will be the total sum of all the Terms.

So in the former Progression given, 3 and 17 is 20, which Multiplyed by 4 (*viz.* half the Number of terms) the Product gives 80, the Sum of all the terms, or multiply 8, (the Number of terms) by 10 (half the sum of the first and last terms) the Product gives 80, as before.

So also 21, 18, 15, 12, 9, 6, 3, being given, the Sum of all the terms will be found to be 84; for here the Number of terms is 7, and the Sum of the first and last (*viz.* 21 and 3) is 24, half whereof (*viz.* 12) multiplyed by 7, produceth 84 the sum of the terms sought.

7. Three *numbers* that differ by Arithmetical *proportion*, the double of the mean (or middle *number*) is equal to the sum of the *Extreams*.

So 9, 12 and 15 being given, the double of the mean 12 (*viz.* 24) is equal to the sum of the *Extreams*, 9 and 15.

8. Four *numbers* that differ by Arithmetical proportion (either continued or interrupted) the sum of the two *means* is equal

equal to the sum of the two *Extreams*. So 9, 12, 18, 21, being given, the sum of 12 and 18 will be equal to the sum of 9 and 21, *viz.* 30; also 6, 8, 14, 16, being given, the Sum of 8 and 14, is equal to the sum of 6 and 16, *viz.* 22. *&c.*

vide Wing. Arithm. chap. 35.

9. Geometrical Proportion (by some called Geometrical Progression) is when divers *numbers* differ according to like Reason.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by double Reason and 3, 9, 27, 81, 243, 729, differ by Triple Reason, 4, 16, 64, 256, *&c.* differ by quadruple Reason, *&c.*

10. In any *numbers* that increase by Geometrical proportion, if you multiply the last term by the Quotient of any one of the *terms*, divided by another of the *terms*, which being less, is next unto it, and having deducted, or subtracted the first *term* out of that product, divide the Remainder by a *number* that is an unit less then the said Quotient, the last quote will give you the sum of all the *Terms*.

So 1, 2, 4, 8, 16, 32, 64, being given, first I take one of the *terms*, *viz.* 8 and divide it by the *term* which is less and next to it, (*viz.* by 4) and the Quo-

```
      64
4)8(  2
    128
      1
  ----
1)127(127
```

 tient

tient is 2, by which I multiply the laſt *term* 64, and the Product is 128, from whence I ſubtract the firſt *term*, (*viz.* 1) the Remainder is 127 which divided by the quotient 2 made leſs by 1 (*viz.* 1,) the quote is 127 for the ſum of all the given *terms*, as by the work in the margent.

So if 4, 16, 64, 256, 1024 were given, the Sum of all the *terms* will be found to be 1364. For firſt I divide 64 one of the *terms* by his next leſſer *term*, and the Quotient is 4, by which I multiply the laſt *term* 1024 and it produceth 4096; from whence I ſubſtract the firſt *term* 4, and the Remainder is 4092, which I divide by the quote leſs 1 (*viz.* 3) and the quote is 1364 for the total ſum of all the *terms*, as *per* margent.

1024
16)64(4
4096
4
3)4092(1364

So likewiſe if 2, 6. 18, 54, 162, 486, were given the ſum or total of all the *terms* will be found to be 728, ſee the work.

486
6) 18 (3
1458
2
2) 1456 (728

11. Three Geometrical proportionals given, the ſquare of the mean is equal to the Rectangle, or Product of the *Extreams*.

So

So 8, 16, 32 being given, the ſquare of the mean, *viz.* 16 is 256, which is equal to the Product of the *Extreams* 8 and 32, for 8 times 32 is equal to 256.

12. Of 4 Geometrical proportional *numbers* given, the Product of the two means, is equal to the Product of the two *Extreams*.

So 8, 16, 32, 64, being given, I ſay that the Product of the two means, *viz.* 16 times 32 which is 512 is equal to 8 times 64 the product of the *Extreams*.

Alſo if 3, 9, 21, 63, were given (which are Interrupted) I ſay 9 times 21 is equal to 3 times 63.

From hence ariſeth (that precious Gem in Arithmetick, which for the excellency thereof is called) the Golden Rule, or Rule of 3.

CHAP. X.

The ſingle Rule of three Direct.

1. THE Rule of Three (not undeſervedly called the Golden Rule) is

that by which we find out a fourth *number*, in *proportion* unto *three* given *numbers*, ſo as this *fourth number* ſought may bear the ſame Rate, Reaſon, or Proportion to the *third* (given) *number*, as the ſecond doth to the firſt, from whence it is alſo called the Rule of *Proportion*.

2. Four *Numbers* are ſaid to be *Proportional*, when the firſt containeth, or is contained by the ſecond, as often as the third containeth, or is contained by the fourth. *Vide Wingates Arith. Chap.* 8. *Sect.* 4.

So theſe *Numbers* are ſaid to be *Proportionals*, viz. 3, 6, 9, 18, for as often as the firſt *Number* is contained in the ſecond, ſo often is the third contained in the fourth, *viz.* twice. Alſo 9, 3, 15, 5, are ſaid to be *Proportional*, for as often as the firſt *Number* containeth the ſecond, ſo often the third *Number* containeth the fourth, *viz.* 3 times.

3. The Rule of Three is either ſimple, or compoſed.

4. The ſimple (or ſingle) Rule of *three*, conſiſteth of 4 *Numbers*, that is to ſay, it hath 3 *Numbers* given to find out a fourth; and this is either Direct, or Inverſe. *Vide Alſted. Math. lib.* 2. *Cap.* 13.

5. The ſingle Rule of *three direct*, is when the *Proportion* of the firſt *term* is to the

the ſecond, as the third is to the fourth; or when it is Required that the *Number* ſought (*viz.*) the fourth *Number* muſt have the ſame *Proportion* to the ſecond, as the third hath to the firſt.

6. In the Rule of *three*, the greateſt difficulty is (after the queſtion is propounded) to diſcover the *order* of the 3 *terms*, *viz.* which is the firſt, which is the ſecond, and which the third, which that you may underſtand obſerve, That (of the three given *Numbers*) two are alwayes of one kind, and the other is of the ſame kind with the *Proportional Number* that is ſought; as in this Queſtion, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 yards coſt at that Rate? here the two *Numbers* of one kind are 4 and 6, *viz.* they both ſignifie ſo many yards; and 12 ſhillings is the ſame kind with the *Number* ſought, for the price of 6 yards is ſought.

Again obſerve, that of the 3 given *number*, thoſe two that are of the ſame kind, one of them muſt be the firſt, and the other the third, and that which is of the ſame kind with the *number* ſought, muſt be the ſecond *number* in the Rule of *three*; and that you may know which of the ſaid *numbers* to make your firſt, and which your third, know this, that to one of thoſe two *Num-*

bers there is always affixed a demand, and that *Number* upon which the demand lyeth muſt always be Reckoned the third *Number*. As in the forementioned Queſtion, the demand is affixed to the *Number* 6, for it is demanded what 6 yards will coſt? and therefore 6 muſt be the third *Number* and 4 (which is of the ſame denomination (or kind) with it) muſt be the firſt, and conſequently the *Number* 12, muſt be the ſecond, and then the *Numbers* being placed in the forementioned order will ſtand as followeth, *viz.*

yards	*s*	*yards*
4	12	6

7. In the Rule of *three Direct* (having placed the *Numbers* as is before directed, the next thing to be done will be to find out the fourth *Number* in proportion which that you may do) Multiply the ſecond *Number* by the third, and divide the Product thereof by the firſt, or (which is all one) multiply the third *term* (or *Number*) by the ſecond and divide the Product thereof by the firſt, and the Quotient thence ariſing is the fourth *number* in a direct proportion, and is the *Number* ſought or Anſwer to the Queſtion, As thus let the

the ſaid Queſtion be again Repeated, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 yards coſt?

Having placed my *Numbers* according to the 6 Rule (of this Chapter) foregoing, I multiply the ſecond *number* 12, by the third *number* 6, and the product is 72, which I divide by the firſt *number* 4, and the quotient thence ariſing is 18, which is the fourth *Proportional* or *number* ſought, *viz.* 18 ſhillings, which is the Price of the 6 yards, as was Required, ſee the work following.

	yards	s.	yards	s.
If	4	12	6	18

6

4) 72 (18 *ſhillings*

4

32

32

(0)

Queſt. 2. Another queſtion may be this, *viz.* If 7 *C.* of Pepper coſt 21 *l.* how much will 16 *C.* coſt at that Rate?

To Reſolve which queſtion, I conſider that (according to the 6 Rule of this Chapter)

ter) the *terms* or *numbers* ought to be placed thus, *viz.* the demand lying upon 16 *C.* it muſt be the third *number*, and that of the ſame kind with it muſt be the firſt, *viz.* 7 *C.* and 21 *l.* (being of the ſame kind with the *number* ſought) muſt be the ſecond *number* in this Queſtion, then I proceed according to this 7 Rule, and multiply the ſecond *number* by the third, *viz.* 21 by 16, and the product is 336 which I divide by the firſt *number* 7, and the Quotient is 48 *l.* which is the value of 16 *C.* of Pepper at the Rate of 21 *l.* for 7 *C.* See the work as followeth.

	C.	*l.*	*C.*
If	7	21	16

16

126
21

l.

7) 336 (48
28

56
56

facit 48 *l.*

0

8. If

8. If when you have divided the product of the ſecond and third *numbers* by the firſt, any thing Remain after Diviſion is ended, ſuch Remainder may be multiplyed by the parts of the next Inferiour denomination, that are equal to a unit (or Integer) of the ſecond *number* in the queſtion, and the product thereof divide by the firſt *number* in the queſtion, and the quotient is of the ſame denomination with the Parts by which you multiplyed the Remainder, and is part of the fourth *number* which is ſought. And furthermore, if any thing Remain, after this laſt Diviſion is ended multiply it by the parts of the next inferiour denomination equal to a unit of the laſt quotient, and divide the product by the ſame diviſor, (*viz.* the firſt *number* in the queſtion) and the quote is ſtill of the ſame denomination with your Multiplier; follow this method until you have Reduced your Remainder into the loweſt denomination, *&c.* An Example or two will make the Rule very plain which may be this following.

Queſt. 3. If 13 *yards* of Velvet (or any other thing) coſt 21 *l.* what will 27 *yards* of the ſame coſt at that Rate?

Having ordered, and wrought, my Numbers according to the 6 and 7 Rules of this chapter, I find the quotient to be 43 *l.* and there

there is a Remainder of 8, ſo that I conclude the price of 27 *yards* to be more than 43 *l.* and to the intent that I may know how much more I work according to the foregoing Rule, *viz.* I multiply the ſaid Remainder 8, by 20 *s.* (becauſe the ſecond *number* in the *Queſtion* was pounds) and the product is 160, which divided by the firſt *number*, *viz.* 13, it quotes 12, which are 12 ſhillings, and there is yet a Remainder of 4, which I multiply by 12 pence (becauſe the laſt Quotient was ſhillings) and the product is 48. which I divide by 13 (the firſt *number*) and the quotient is 3 *d.* and yet there Remaineth 9, which I multiply by 4 *farthings*, and the product is 36, which divided by 13 again, it quotes 2 *farthings*, and there is yet a Remainder of 10, which (becauſe it cometh not to the value of a *farthing*) may be neglected, or Rather ſet (after the 2 *farthings*) over the Diviſor with a line between them, and then (by the 21 and 22 definitions of the firſt Chapter of this book) it will be $\frac{10}{13}$ of a *farthing*; So that I conclude, that if 13 *yards* of Velvet coſt 21 *l.* 27 *yds.* of the ſame will coſt 43 *l.* 12 *s.* 3 *d.* 2 $\frac{10}{13}$ *qrs.* which Fraction is ten thirteenths of a *farthing*. See the operation as followeth.

If

yds. l. yds.
If 13—21—27
27

147
42

13) 567 (43 *l.*
52

47
39

Remains (8)
Multiply 20

13) 160 (12 *s.*
13

30
26

Remains (4)
Multiply 12

13) 48 (3 *d.*
39

Remains (9)
Multiply 4

qrs.
13) 36 ($2\frac{10}{13}$
26

	l.	*s.*	*d.*	*qrs.*
Remains 10 *facit*	43	12	3	$2\frac{10}{13}$

Queſt.

Queſt. 4. Another Example may be this following, *viz.* If 14 *l.* of Tobacco coſt 27*s.* what will 478 *l.* coſt at that rate?

Work according to the laſt Rule, and you will find it to amount to 921 *s.* 10 *d.* $1\frac{2}{14}$ *qrs.* and by the 5 Rule of the 8 Chapter 921 *s.* may be Reduced to 46 *l.* 01 *s.* So that then the whole worth or value of the 478 *l.* will be 46 *l.* 01 *s.* 10 *d.* $1\frac{2}{14}$ *qrs.* the whole work followeth.

14

```
        l.   s.   l.
If 14—27—478
              27
            ----
            3346
            056
            ----
      14) 12906 (921
          126
          ----
           30
           28
           ----
           26
           14
           ----
  2|0) 92|1 ( 46
       8
       --
       12      Remains (12)
       12      Multiply  12
       --                ---
       01                 24
                          12
                          ---
                  14) 144 (10
                      14
                      ---
          Remains      4
          Multiply     4
                      ---   qrs.
                  14) 16 (1 2/14
                      14
                      ---
          Rem.        (2)
        l.   s.   d.   qrs.
Facit  46—01—10——1 2/14
```

9. In the Rule of 3 it many times happeneth that although the first and third *numbers*

numbers be Homogeneal (that is, of one kind) as both money, weight, meaſure, *&c.* yet they may not be of one denomination, or perhaps they may both conſiſt of many denominations, in which caſe you are to reduce both *number's* to one denomination; and likewiſe your ſecond *number* (if it conſiſteth of diverſe denominations) muſt be reduced to the leaſt name mentioned, or lower if you pleaſe which being done, multiply ſecond and third together and divide by the firſt, as is directed in the 7 Rule of this Chapter.

And note that alwayes the Anſwer to the queſtion is in the ſame denomination that your ſecond *number* is of, or is Reduced to.

Queſt. 5. If 15 ounces of Silver be worth 3 *l.* 15 *s.* what are 86 ounces worth at that Rate?

In this queſtion the *numbers* being ordered according to the 6 Rule of this Chapter, the firſt and third *numbers* are ounces, and the ſecond *number* is of diverſe denominations, *viz.* 3 *l.* 15 *s.* which muſt be Reduced to Shillings, and the ſhillings multiplyed by the third number, and the Product divided by the firſt gives you the Anſwer in ſhillings, *viz.* 430 *s.* which are reduced to 21 *l.* 10 *s.* See the work.

If

oz.	l.	s.	oz.
If 15	3	15	86

20

75
86

450
600

210) l. s.
15) 6450 (4310 (21 — 10
60 4

45 3
45 2

(0) (10) *ſhillings*

In reſolving the laſt queſtion the work would have been the ſame if you had reduced your ſecond Number into pence, for then the Anſwer would have been 5160 pence, equal to 21 *l.* 10 *s.* or if you had Reduced the Second *number* into *farthings* the Quotient, or Anſwer, would have been 20640 *farthings* equal to the ſame, as you may prove at your leiſure.

Queſt. 6. If 8 *l.* of Pepper coſt 4 *s.* 8 *d.* what will 7 *C.* 3 *qrs.* 14 *l.* coſt?

In this Queſtion the firſt *number* is 8 *l.* and the third is 7 *C.* 3 *qrs.* 14 *l.* which muſt be reduced to the ſame denomination with the firſt, *viz.* into pounds, and the ſecond *number* reduce into pence, then Multiply and

Divide

Divide, according to the 7 Rule foregoing and you will find the answer to be 6174 *pence* which is reduced into 25 *l.* 14 *s.* 6 *d.*

	l.	s.	d.		C.	qrs.	l.
If	8	4	8		7	3	14
		12				4	
		56				31	
						28	
						252	
						63	
						882	
						56	
						5292	
						4410	
						12)	210)
				8)	49392	(6174	(5114 (25
					....	....	
					48	60	4
					13	17	11
					8	12	10
					59	54	14 *shill.*
					56	48	
					32	(6)	*pence*
					32		
					(0)		l. s. d.
						Facit	25 14 6

Queſt. 7. If 3 *C.* 1 *qrs.* 14 *l.* of Raiſons coſt 9 *l.* 9 *s.* what will 6 *C.* 3 *qrs.* 20 *l.* of the ſame coſt?

Here

Here the first and third *numbers* each consist of divers denominations, but must be brought both into one denomination *&c.* as you see in the operation which followeth; the Answer is 388 *s.* which is Reduced into 19 *l.* 8 *s.*

C.	qrs.	l.		l.	s.		C.	qrs.	l.	
If 3	— 1	— 14	*cost*	9	— 9	*what will*	6	— 3	— 20	*cost.*
4				20			4			
13				189			27			
28							28			
108							216			
27							56			
378 *pounds*							776 *pounds*			
							189			
							6984			
							6208			
							776			
							210)			l. s.
						378)	146664	(3818		(19-8
							...	2		
							1134	—		
								18		
							3326	18		
							3024	—		
								(08)		*shil.*
							3024			
							3024			l. s.
								facit		19 8
							(0)			

Quest.

Queſt. 8. If in 3 *weeks* 4 *days* I ſpend 13 *s.* 4 *d.* how long will 53 *l.* 06 *s.* laſt me at that Rate?

Anſwer, 2238 *dayes* equal to 6 *years* 48 *dayes.* See the work.

s.	*d.*	*w.*	*d.*	*l.*	*s.*
If 13	—4 *Require*	3	—4 *what will*	53	—06
12		7		20	
30		28 *dayes*		1066	
13				12	
160 *pence*				2132	
				1066	
				12792 *pence*	
				28	
				102336	
				25584	
				365)	
				1610) 3581716 (	2238 (6 *y.*
					2190
				32	
				Rem.	(48) *days*
				38	
				32	
				61	*y. days.*
				48	*facit* 6—48
				137	
				128	
				Remains (96)	

Queſt

Queſt. 9. Suppoſe the yearly Rent of a houſe, a yearly penſion, or wages be 73 l. I deſire to know how much it is *per* day?

Here you are to bring the year into days, and ſay, If 365 days Require 73 *l.* what will 1 day Require?

Now when you come to multiply 73 by 1 the product is the ſame, for 1 neither multiplyeth nor divideth, and 73 cannot be divided by 365 becauſe the diviſor is bigger than the dividend, wherefore bring the 73 *l.* into ſhillings, and they make 1460, which divide by the firſt *number* 365, and the quote is 4 ſhillings for the Anſwer, as you ſee in the work.

days	*l.*	*days*
If 365	73	1
	20	
	1460	

365) 1460 (4 *s.*
1460
(0)

facit 4 *s.*

Queſt. 10. A Merchant bought 14 pieces of broad-cloath, each piece containing 28 *yards*, for which he gave after the Rate of 13 *s.* 6 *d* $\frac{1}{2}$ *per yard*, now I deſire to know how much he gave for the 14 pieces at that Rate.

Firſt find out how many yards are in the 14 pieces which you will do if you multiply the 14 pieces by 28 the *number* of yards in a piece, and it makes 392, then ſay If 1 yard coſt 13 *s.* 6 *d.* ½ what will 392 yards coſt? work as followeth and the Anſwer you will find to be 127400 half-pence, which Reduced make 265 *l.* 8 *s.* 4 *d.* For after you have multiplyed your ſecond and third *numbers* together the product is 127400, which (according to the Rule) ſhould be divided by the firſt number, but the firſt number is 1, which neither multiplyeth nor divideth, and therefore the quotient, or fourth *number* is the ſame with the Product of the ſecond and third, which is in half-pence becauſe the ſecond *number* was ſo Reduced. See the work.

28

28
14

112
28

392 *yards in the* 14 *pieces*

yds.	*s.*	*d.*		*yds.*		
If 1 *coſt*	13	$6\frac{1}{2}$	*what will*	392	*coſt?*	
	12			325		
	32			1960		
	13			784		
	162			1176		
	2			24) 127400	(53018	(265
	325			120	4	
				74	13	
				72	12	
	l.	*s.*	*d.*	200	10	
Facit	265	8	4	192	10	

(08) *ſhillings.*

Rem. (8) $\frac{1}{2}$ *pence or* 4 *d.*

Queſt. 11. A Draper bought 420 *yards* of broad-cloth, and gave for it after the Rate of 14 *s.* 10 *d.* $\frac{3}{4}$ *per* Ell *Engliſh*, now I demand how much he paid for the whole at that Rate?

Bring your ell into quarters and your yards given into quarters, the ell is 5 quarters and in 420 yards are 1680 quarters, then say, If 5 quarters cost 14 *s.* 10 *d.* $\frac{3}{4}$ or 715 *farthings*, what will 1680 quarters cost? *facit* 250 *l.* 05 *s.* 00 *d.*

ell	*yards*
1	420
5	4
5 *qrs.*	1680 *qrs.*

qrs.	*s.*	*d.*	*qrs.*
If 5	14	$10\frac{3}{4}$	1680
	12		715
	28		8400
	15		1680
	178 *d.*		11760
	4		5) 1201200 (240240 (250
	715 *qrs.*		10 192
			20 482
Facit	250	05 — 00	20 480
			12 *Rem.* (240) *qrs.* or 5*s.*
			10
			20

Queſt. 12. A Draper bought of a Merchant 50 pieces of Kerſies each piece containing

34 Ells flemiſh, (the Ell *Flemiſh* being 3 quarters of a yard) to pay after the Rate of 8 *s.* 4 *d. per* Ell *Engliſh*, I demand how much the 50 pieces coſt him at that Rate?

Firſt find how many Ells *Flemiſh* are in the 50 pieces by multiplying 50 by 34, the product is 1700 which bring into quarters by 3 it makes 5100 quarters, then proceed as in the laſt queſtion, and the Anſwer you will find to be 102000 pence or 425 *l.*

qrs. s. d. *qrs.*

If 5—8—4 —— 5100 50

12 100 34

d.

100 *d.* 5) 510000 (102000 200

150

5 1700 *ells Flemiſh.*

10 3

10 5100 *quarters.*

(0) 210) *l.*

12) 102000 (8500 (425

96 8

60 5

60 4

(0) 10

10

(0)

Queſt. 13. A Goldſmith bought a wedge of Gold which weighed 14 *l.* 3 *oz.* 8 *p.w.* for the ſum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* ounce? Anſwer 60 ſhillings or 3 *l.* See the work.

l.	*oz.*	*p.w.*	*l.*	*s.*	*oz.*
If 14	3	8	514	4	1
12			20		20
31			10284	*ſhill.*	20 *p.w.*
14			20		
171 *oz.*		3428)	205680	(6lo (3*l.*	
20			6		
3428 *p.w.*			20568	*s.*	*l.*
			(o)	*facit* 60	*or* 3
			(o)		

Queſt. 14. A Grocer bought 4 hhds of Sugar, each weighing neat 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2 *l.* 8 *s.* 6 *d. per C.* I demand the value of the 4 hhds. at that Rate?

Firſt find the weight of the 4 hhds, which you may do by Reducing the weight of one of them into pounds, and multiply them by 4 (the number of hhds) and they make 2968 *l.* then ſay, If 1 *C.* or 112 *l.* coſt 2 *l.* 8 *s.* 6 *d.* what will 2968 *l.* coſt? *Facit* 64 *l.* 5 *s.* 3 *d,* as by the operation.

```
                                        C. qrs. l.
                                        6--2--14
                                        4
                                        --
                                        26
                                        28
                                        ---
  l.   l.  s.  d.      l.              212
If 112--2--8--6---2968                 53
      20              582              ---
      --              ---              742 l. in 1 hhd.
      48             5936                4
      12            23744              ---
     ---            14840             2968 l. in 4 hhds.
     102            ------            12)     2l0)     l.
      48     112) 1727376 (15423 (128l5 (64
     ---            .....   ....    ..
     582            112      12      12
                    ---      ---     ---
                    607      34       8
                    560      24       8
                    ---      ---     ---
                    473      102     (05) shill.
                    448       96
                    ---      ---
                    257       63
                    224       60
                    ---      ---
                    336     (3) pence
                    336
                    ---
                     (0)
                  l.    s.    d.
        Facit     64---5---3
```

Queſt. 15. A Draper bought of a Merchant 8 Packs of Cloth, each pack containing 4 parcels, and each parcel 10 pieces, and in each piece 26 yards, and gave after the Rate of 4 *l.* 16 *s.* for 6 *yards*, now I deſire to know how much he gave for the whole, Anſwer 6656 *l.*

Firſt find out how many yards there were in the 8 packs, as by the following work, you will find there are 8320 yards; then ſay, If 6 *yards* coſt 4 *l.* 16 *s.* what will 8320 *yards* Coſt, *&c.*

If

```
                                                  8 packs.
                                                  4
                                                 ---
                                                 32 parcels
                                                 10
                                                ----
                                                320 pieces
 yds.   l.      s.      yds.                     26
If 6---4---16---8320                            ----
      20                96                      1920
      --              -----                     640
      96.             49920                    ----
                      74880                    8320 yards
                      -----          2l0)        l.
                 6) 798720 (13312l0 (6656
                    ......   ....
                    6        12
                    --       --
                    19       13
                    18.      12
                    --       --
                    18       11
                    18       10
                    --       --
                    07       12
                     6       12
                    --       --
                    12       (0)
                    12.
facit 6656 l.       --
                    (0)
```

By this time the Learner is (ſurely) well Exerciſed in the Practick and Theorick of the Rule of 3 Direct, but at his leiſure he

may look over the following Queſtions, whoſe Anſwers are given, but the operation purpoſely omitted as a Touchſtone for the Learner, thereby to try his ability in what hath been delivered in the former Rules.

Queſt. 16. If 24 *l.* of Raiſons coſt, 6 *s.* 6 *d*, what will 18 Frails coſt, each weighing Neat 3 *qrs.* 18 *l.*? *Anſwer* 24 *l.* 17 *s.* 03 *d.*

Queſt. 17. If an ounce of Silver be worth 5 ſhillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10 *p.w.*? *Anſwer* 313 *l.* 05 *s.*

Queſt. 18. If A piece of Cloth coſt 10 *l.* 16 *s.* 8 *d.* I demand how many ells *Engliſh* there are in the ſame, when the Ell at that Rate is worth 8 *s.* 4 *d.* *Anſwer* 26 Ells *Engliſh.*

Queſt. 19. A Factor bought 84 pieces of Stuffs, which coſt him in all 53 *l.* 12 *s.* at 5 *s.* 4 *d.* *per yards*, I demand how many *yards* there were in all, and how many Ells *Engliſh* were contained in a piece of the ſame? *Anſwer* 2016 *yards* in all, and 19$\frac{1}{5}$ Ells *Engliſh per* piece.

Queſt. 20. A Draper bought 240 *yards* of Broad-cloth, which coſt him in all 254 *l.* 10 *s.* for 86 *yards* of which he gave after the Rate of 21 *s.* 4 *d.* *per yard*, I demand how

how much he gave *per yard* for the Remainder? *Answer* 20 *s.* $10\frac{64}{156}$ *d. per yards.*

Quest. 21. A Factor bought a certain quantity of Serge, and Shalloon, which together cost him 226 *l.* 14 *s.* 10 *d.* the Quantity of Serge he bought was 48 *yds.* at 3 *s.* 4 *d. per yd.* and for every 2 *yds.* of Serge he had 5 *yards* of Shalloon, I demand how many *yards* of Shalloon he had, and how much the Shalloon cost him *per yard?* Answer 120 *yards* of Shalloon at 1 *l.* 16 *s.* $05\frac{58}{120}$ *d per yard.*

Quest. 22. An Oylman bought 3 Tun of Oyl, which cost him 151 *l.* 04 *s.* and it so chanced that it leaked out 85 gallons, but he is minded to sell it again so as that he may be no looser by it, I demand how he must sell it *per gallon? Answer* at 4 *s.* $6\frac{54}{85}$ *d. per gallon.*

Quest 23. Bought 6 packs of cloth, each pack containing 12 Cloaths, which at 8 *s.* 6 *d. per* Ell *Flemish* cost 1080 *l.* I demand how many yards there were in each Cloth? *Answer* 27 *yards* in each Cloth.

Quest. 24. A Gentleman hath 536 *l. per annum,* and his expences are one day with another 18 *s.* 10 *d.* 3 *qrs.* I desire to know how much he layeth up at the years end? *Answer* 191 *l.* 03 *s.* 00 *d.* 1 *qrs.*

Queſt. 25. A Gentleman expendeth dayly one day with another 27 *s.* 10 *d.* $\frac{1}{2}$ and at the years end layeth up 340 *l.* I demand how much is his yearly Income? *Anſwer* 848 *l.* 14 *s.* 4 *d.* $\frac{1}{2}$.

Queſt. 26. If I ſell 14 *yards* for 10 *l.* 10 *s.* 00 *d.* how many Ells *Flemiſh* ſhall I ſell for 283 *l.* 17 *s.* 06 *d.* at that Rate? Anſwer 504 $\frac{2}{3}$ Ells *Flemiſh.*

Queſt. 27. If 100 *l.* in 12 moneths gain 6 *l.* Intereſt, how much will 75 *l.* gain in the ſame time, and at the ſame Rate? *Anſwer* 4 *l.* 10 *s.*

Queſt. 28. If 100 *l.* in 12 moneths gain 6 *l.* Intereſt, how much will it gain in 7 moneths at that Rate? *Anſwer* 3 *l.* 10 *s.*

Queſt. 29. A certain Uſurer put out 75 *l.* for 12 Moneth, and Received principle and Intereſt 81 *l.* I demand what rate *per Cent.* he Received Intereſt? *Anſwer,* 8 *l. per Cent.*

Queſt. 30. A Grocer bought 2 Cheſts of Sugar the one weighed neat 17 *C.* 3 *qrs.* 14 *l.* at 2 *l.* 6 *s.* 8 *d. per C.* the other weighed neat 18 *C.* 1 *qrs.* 21 *l.* at 4 *d* $\frac{1}{2}$ *per l.* which he mingleth together, now I deſire to know how much a *C. weight* of this mixture is worth? *Anſwer* 2 *l.* 4 *s.* 3 *d.* $2\frac{53}{107}$ *qrs.*

Queſt.

Queſt. 31. Two men *viz.* A and B, departed both from one place, the one goes Eaſt, the other Weſt, the one travaileth 4 miles a day, the other 5 miles a day, how far are they diſtant the 9th day after their departure? *Anſwer* 91 miles.

Queſt. 32. A flying every day 40 miles, is purſued the 4th day after by B, poſting 50 miles a day, now the Queſtion is in how many dayes, and after how many miles Travail will A be overtaken? *Anſwer*, B overtakes him in 12 dayes, when they have Travailed 600 miles.

Moor. Arithm. Chap. 8. *Queſt.* 7.

11. The General Effect of the Rule of three Direct, is contained in the definition of the ſame, that is, to find a fourth number in proportion conſiſting of two equal Reaſons, as hath been fully ſhewn in all the foregoing Examples.

The ſecond Effect is, by the price or value of one thing to find the price or value of many things of like kind?

The third Effect, is by the price or value of many things to find the price of 1, or by the price of many things (the ſaid price being 1) to find the price of many things of like kind.

The fourth Effect is, by the price or value of many things, to find the price or value of many things of like kind.

The fifth Effect is, thereby to Reduce any Number of moneys, weight or meaſure the one ſort into the other, as in the Rules of Reduction contained in the 8 Chapter foregoing. Examples of its various Effects have been already Anſwered.

12. The Rule of 3 Direct is thus proved, *viz.* Multiply the firſt Number by the fourth, and note the product, then multiply the ſecond Number by the third, and if this product is equal to the product of the firſt and fourth, then the work is Rightly performed, otherwiſe it is Erroneous.

The proof of the Rule of Three Direct.

So the firſt Queſtion of this Chapter (whoſe Anſwer, or fourth Number we found to be 18 *s.*) is thus proved, *viz.* the firſt Number is 4, which multiplyed by 18 (the fourth) produceth 72. And the ſecond and third Numbers are 12 and 6, which multiplyed together produce 72, equal to the product of the firſt and fourth, and therefore I conclude the work to be Rightly performed.

All-

Always obſerving, that if any thing Remain after you have divided the product of the ſecond and third Numbers, by the firſt, ſuch Remainder in proving the ſame, muſt be added to the product of the firſt and fourth *Numbers*, whoſe ſum will be equal to the product of the ſecond and third, (the ſecond *number* being of the ſame denomination with the fourth, and the firſt with the ſame denomination of the third.)

So the Fourth Queſtion of this Chapter, being again repeated, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that Rate? the Anſwer (or 4th *number*) was 46 *l.* 01 *s.* 10 *d.* 1 *qrs.* $\frac{2}{4}$ which is thus proved, *viz.* bring the fourth *number* into *farthings* and it makes 44249 which multiplyed by the firſt *number* 14 produceth 619488 (the 2 which remained being added thereto) then (becauſe I Reduced my fourth *number* into *farthings*) I Reduce my ſecond (*viz.* 27 *s.*) into *farthings* and they are 1296 which multiplyed by the third *number* 478, their product is 619488 equal to the product of the *firſt* and *fourth Numbers*. Wherefore I conclude the operation to be true. This is an Infallible way to prove the Rule of 3 *Direct*, and it is deduced from the twelfth *Sect.* of the 9th. *Chap.* of this Book.

Thus

Thus much concerning the ſingle Rule of 3 *Direct*, and I Queſtion not but by this time the Learner is ſufficiently quallified to Reſolve any Queſtion pertinent to this Rule, not Relying upon *fractions*, or *Geometrical magnitudes*. Thoſe that are deſirous to ſee the demonſtration of this Rule, let them Read the 6th. *Chapter* of (the Ingenious) Mr. *Kerſies* Appendix to *Wingates* Arithmetick. Or the 6th. *Chapter* of Mr. *Oughtreds* (Incomparable) *Clavis Mathematicæ*: By both which Authors this Rule is largely demonſtrated, being grounded upon the 19 *Prop.* of the 7th, and the 19 *Prop.* of the 9th. of *Euclids Elem.*

Chap.

CHAP. XI.

The ſingle Rule of three Inverſe.

1. THE Golden Rule or Rule of 3 Inverſe is when there are 3 *Numbers* given to find a 4th. in ſuch Proportion to the 3 given *Numbers*, ſo as the 4th. proceeds from the ſecond, according to the ſame Rate, Reaſon, or Proportion that the firſt proceeds from the third, or the Proportion is

As the third *number* is in proportion to the ſecond, ſo is the firſt to the fourth. *Alſted. Math. lib. 2. cap. 14.*

So if the 3 *numbers* given were 8, 12, and 16, and it were Required to find a 4th. *number* in an inverted proportion to theſe, I ſay that as 16 (the *third Number*) is the double of the firſt *term* or *number* (8) ſo muſt 12 (the ſecond *number*) be the double of the 4th; ſo will you find the 4th. *term* or *number* to be 6. And as in the Rule of 3

Direct

Direct, you multiply the ſecond and third together, and divided their product for a 4th *Proportional number*, So

2. In the Rule of 3 *Inverſe*, you muſt Multiply the ſecond *term* by the firſt (or firſt *term* by the ſecond) and divide the product thereof by the 3d. *term*, ſo the Quotient will give you the 4th. *term* ſought in an Inverted *Proportion*. The ſame order being obſerved in this Rule as in the Rule of 3 *Direct*, for placing or diſpoſing of the given *numbers*, and after your *numbers* are placed in order, that you may know whether your Queſtion be to be Reſolved by the Rule *Direct* or *Inverſe*, obſerve the general Rule following.

3. When your Queſtion is ſtated, and your *numbers orderly* diſpoſed, Conſider in the 1ſt. place whether the 4th. *term* or *number* ſought, ought to be more, or leſs then the ſecond *term*; which you may eaſily do; And if it is required to be more, or greater then the ſecond *term*, then the leſſer *Extream* muſt be your diviſor, but if it require leſſe, then the biggeſt *Extream* muſt be your Diviſor, (In this Caſe the 1ſt and 3d *numbers* are called *Extreams* in Reſpect of the ſecond) and having found out your Diviſor, you may know whether your Queſtion belong to the Rule *Direct* or

Inverſe

Inverſe, for if the 3d. *term* be your Diviſor, then it is *Inverſe*, but if the firſt *term* be your Diviſor, then it is a *Direct* Rule. As In the following Queſtions.

Queſt. 1. If 8 Labourers can do a certain piece of work in 12 dayes in how many dayes will 16 Labourers do the ſame? Anſwer in 6 dayes.

Having p'aced the *numbers* according to the 6 Rule of the 10th. Chapter. I conſider that if 8 men can finiſh the work in 12 dayes, 16 men will do it in leſſer (or fewer dayes then 12) therefore the biggeſt *Extream* muſt be the Diviſor which is 16 and therefore it is the Rule of 3 *Inverſe*, wherefore I multiply the firſt and ſecond *numbers* together *viz.* 8 by 12 and their *product* is 96, which divided by 16 Quotes 6 days for the *Anſwer*, and in ſo many days will 16 Labourers perform a piece of work when 8 can do it in 12 days.

lab.	*day.*	*lab.*
8	12	16

8

16) 96 (6 *dayes*

96

(0)

facit 6 *dayes.*

Queſt. 2. If when the meaſure (*viz.* a peck) of wheat coſt 2 ſhillings the peny Loaf weighed (according to the Standard, Statute, or Law of *England*) 8 ounces, I demand

demand how much it will weigh when the peck is worth 1 *s.* 6 *d.* according to the ſame Rate or Proportion? *Anſwer* 10 *oz.* 13 *p.w.* 8 *grs.*

Having placed and reduced the given *Numbers* according to the 6 and 9 rules of the 10th Chapter I conſider that at 1 *s.* 6 *d. per* Peck, the peny Loaf will, weigh more then at 2 *s. per* Peck, for as the price decreaſeth, the weight Increaſeth, and as the price Increaſeth ſo the weight diminiſheth, wherefore becauſe the term Requireth more then the ſecond, the leſſer *Extream* muſt be the Diviſor, *viz.* 1 *s.* 6 *d.* or 18 *pence*, and having finiſhed the work I find the *Anſwer* to be 10 *oz.* 13 *p.w.* 8 *gr.* and ſo much will the peny Loaf weigh, when the peck of wheat is worth 1 *s.* 6 *d.* according to the given Rate of 8 ounces, when the peck is worth 2 ſhillings, the work is plain in the following operation.

s.		s.	d.
2	8	1	6
12	24	12	
24	32	18	
	16		

	oz.	p.w.	gr.
18) 192	(10	13	8
18			
Rem. (12)			
20			
	p.w.		
18) 240	(13		
18			
60			
54			
(6)			
24			
	gr.		
18) 144	(8		
144			
(0)			

Queſt. 3. How many pieces of money or Merchandize at 20 *s. per* piece, are to be given, or Received for 240 pieces, the value or price of every piece being 12 ſhillings? Anſwer 144. For if 12 *s.* Require 240 pieces, then 20 ſhillings will Require leſs; therefore the biggeſt *Extream* muſt

must be the Divisor, which is the 3 *number*, *&c.* See the work.

s.	*pieces*	*s.*
If 12	240	20

12

480
240

210) 28810 (144 *pieces at* 20 *s. per piece*
2

8
8

8
8

(0)

Quest. 4. How many yards of 3 quarters broad are Required to double, or be equal in measure to 30 yards, that are 5 quarters broad? *Answer* 50 yards. For say If 5 quarter wide Require 30 yards long, what length will three quarters broad require? here I consider that 3 quarters broad will Require more yards then

qrs.	*long*	*qrs.*
5	30	3

5

3) 150 (50 *yards*
15

(0)

then 30, for the narrower the cloth is, the more in length will go to make equal meaſure with a broader piece.

Queſt. 5. At the Requeſt of a friend I lent him 200 *l.* for 12 moneths, promiſing to do me the like Curteſie at my neceſſity, but when I came to Requeſt it of him he could let me have but 150 *l.* now I deſire to know how long I may keep this money to make plenary Satisfaction for my former kindneſs to my Friend? *Anſwer*, 16 Moneths.

I ſay, If 200 *l.* Require 12 Moneths, what will 150 *l.* Require? 150 *l.* will Require more time then 12 Moneths, therefore the leſſer *extream* (viz. 150) muſt be the Diviſor, Multiply and Divide, and you will find the 4th inverted *Proportional* to be 16, and ſo many Moneths I ought to keep the 150 *l.* for ſatisfaction.

Queſt. 6. If for 24 *s.* I have 1200 *l.* weight carried 36 M. how many M. ſhall 800 *l.* be carried for the ſame mony? *Anſwer*, 24 M.

Queſt. 7. If for 24 *s.* I have 1200 *l.* carried 36 Miles how many pound weight ſhall I have carried 24 miles for the ſame money? *Anſwer*, 800 *l. weight.*

Queſt. 8. If 100 workmen in 12 dayes finiſh a piece of work or ſervice, how many workmen are ſufficient to do the ſame

in

in 3 dayes? *Answer* 400 workmen.

Quest. 9. A Colonel is besieged in a Town in which are 1000 Souldiers, with provision of Victuals only for 3 Moneths, the Question is how many of his Souldiers must he dismiss that his Victuals may last the Remaining Souldiers 6 Moneths? *Answer*, 500 he must keep, and dismiss as many.

Quest. 10. If wine worth 20 *l.* is sufficient for the ordinary of 100 men, when the Tun is sold for 30 *l.* how many men will the same 20 pounds worth suffice when the Tun is worth 24 *l.* Answer, 125 men.

Quest. 11. How much plush is sufficient to line a Cloak which hath in it 4 yards of 7 quarters wide, when the Plush is but 3 quarters wide? Answer $9\frac{1}{3}$ *yds.* of Plush.

Quest. 12. How many yards of Canvas that is Ell wide will be sufficient to line 20 yards of Say that is 3 quarters wide? Answer, 12 yards.

Quest. 13. How many yards of matting that is 2 foot wide, will cover a floor that is 24 foot long, and 20 foot broad, Answer, 240 foot.

Quest. 14. A Regiment of Souldiers consisting of 1000 are to have new Coats, and each coat to contain 2 *yds.* 2 *qrs.* of Cloth that is 5 *qrs.* wide, and they are to be

be lined with Shalloon that is 3 quarters wide, I demand how many yards of Shalloon will line them? *Anſwer*, 16666⅔ yards?

Queſt. 15. A Meſſenger makes a Journey in 24 dayes when the day is 12 hours long, I deſire to know in how many dayes he will go the ſame when the day is 16 hours long? *Anſwer*, in 18 dayes.

Queſt. 16. Borrowed of my friend 64 *l.* for 8 Moneths, And he hath occaſion another time for to borrow of me for 12 Months, I deſire to know how much I muſt lend to make good his former kindneſs to me? *Anſwer* 42 *l.* 13 *s.* 4 *d.*

4. The General Effect of the Rule of 3 *Inverſe* is contained in the Definition of the ſame, that is, to find a fourth *term* in a Reciprocal *Proportion*, inverted to the *Proportion* given.

The ſecond Effect, is by two priſes or values of two ſeveral pieces of money or Merchandize known, to find how many pieces of the one price is to be given for ſo many of the other. And conſequently to Reduce or Exchange one ſort of Money, or Merchandize, into another. Or contrariwiſe to find the price unknown of any piece given to Exchange, in Reciprocal *Proportion.*

The third Effect, is by two differing prizes of a meaſure of wheat bought or ſold, and the weight of the Loaf of bread, made anſwerable to one of the priſes of the meaſure given, to find out the weight of the ſame Loaf, anſwerable to the other price of the ſaid meaſure given. Or contrariwiſe by the two ſeveral weights of the ſame prized Loaf, and the price of the meaſure of wheat anſwerable to one of thoſe weights given, to find out the other price of the meaſure anſwerable to the other weight of the ſame Loaf.

The Fourth Effect, is by two lengths and one breadth of two Rectangular planes known, to find out another breadth unknown. Or by two breadths and one length given, to find out another length unknown in an inverted *Proportion*.

The fifth Effect, is by double time and a Capitall ſum of money borrowed or lent, to find out another Capital ſum anſwerable to one of the given times, Or contrariwiſe, by two Capital ſums, and a time anſwerable to one of them given, to find out a time anſwerable to the other Capital ſum in Reciprocal Reaſon.

The ſixth Effect is, by two differing weights of Carriage, and the diſtance of the places in Miles or in Leagues given, to find

find another distance in miles answerable to the same price of payment, Or otherwise by two distances in miles and the weight answerable to one of the distances (being carried for a certain price) to find out the weight answerable to the other distance for the same price.

The seventh Effect, is by double workmen, and the time answerable to one of the *numbers* of workmen given, to find out the time answerable to the other *number* of workmen, in the performance of any work or service. Or contrariwise, by double time, and the workmen answerable to one of those times given, to find out the *number* of workmen answerable to the other time, in the performance any work or service.

Also by a double price of provision, and the *number* of men, or other Creatures nourished for a certain time, answerable to one of the prises of provision given, to find out another *number* of Men or other Creatures answerable to the other price of the provision for the same time. Or contrariwise by two *numbers* of Men or other Creatures nourished, and one price of provision answerable to one of the *numbers* of Creatures given, to find out the other price of the same provision answerable to the other *number* of Creatures, both being sup-

poſed to be nouriſhed for the ſame time, *&c.* As in the foregoing Examples is fully declared.

To prove the operation of the Rule of 3 *Inverſe*, multiply the third and fourth *terms* together, and note their product, then multiply the firſt and ſecond together, and if their product is equal to the product of third and fourth, then is the work truly wrought, but if it falleth out otherwiſe then it is erroneous.

As in the firſt Queſtion of this Chapter the product of 16 (the third *number*) multiplyed by 6 (the 4th. *number*) is 96, and the product of 8 (the firſt *number*) multiplyed by 12 (the ſecond *number*) is 96, equal to the firſt product which proves the work to be Right.

And Note, that if in Diviſion any thing Remain, ſuch Remainder muſt be added to the product of third and 4th. terms, and if the ſum be equal to the product of the firſt and ſecond (the homogeneal terms being of one denomination) the work is Right.

CHAP. XII.

The double Rule of three Direct.

WE have already delivered the Rules of *Single Proportion*, and we come now to lay down the Rules of *Plural Proportion*.

1. *Plural Proportion*, is when more operations in the Rule of 3 than one, are Required before a Solution can be given to the Queſtion propounded. Therefore in Queſtions that Require Plurality in *Proportion*, there are alwayes given more then three *numbers*.

2. When there are given 5 *numbers*, and a ſixth is Required in *Proportion* thereunto, then this ſixth *Proportional* is ſaid to be found out by the double Rule of 3, as in the Queſtion following, *viz.*

If 100 *l.* in 12 Months gains 6 *l.* Intereſt, how much will 75 *l.* gain in 9 Months?

3. Queſti-

3. Questions in the double Rule of 3 may be Resolved either by two single Rules of three, or by one single Rule of 3 compounded of the 5 given *Numbers*.

4. The double Rule of three is either *Direct* or else *Inverse*?

5. The double Rule of 3 *Direct* is when unto 5 given *Numbers* a sixth *Proportional* may be found out by two single Rules of three *Direct*.

6. The 5 given *Numbers* in the double Rule of three, consist of two parts, *viz.* *first* a Supposition, and *secondly* of a Demand. The Supposition is contained in the *three first* of the 5 given *Numbers*, and the Demand lies in the two last; as in the Example of the second Rule of this Chapter, *viz.* If 100 *l.* in 12 Months gain 6 *l.* Interest, what will 75 *l.* gain in 9 Months? here the Supposition is expressed in 100, 12, and 6, for it is said if (or suppose) 100 *l.* in 12 Months gain 6 *l.* Interest; and the Demand lyeth in 75 and 9; for it is demanded how much 75 *l.* will gain in 9 Months?

7. When your Question is stated, the next thing will be to dispose of the given *Numbers* in due order and place, as a preparative for Resolution; which that you may do, first observe which of the given

Num-

Numbers in the Suppoſition is of the ſame denomination with the *Number* Required; for that muſt be the ſecond *Number* (in the firſt *operation*) of the *ſingle* Rule of 3, and one of the other *Numbers* in the Suppoſition (it matters not which) muſt be the firſt *Number*, and that *Number* in the demand which is of the ſame denomination with the firſt, mu t be the third *Number*, which three *Numbers* being thus placed, will make one perfect Queſtion in the *ſingle* Rule of three, as in the forementioned Example, firſt I conſider, that the *Number* Requ red in the Queſtion is the Intereſt or Gain, of 75 *l.* therefore that *Number* in the Suppoſition which hath the ſame name (*viz.* 6 *l.* which is the Intereſt or Gain of 100 *l.*) muſt be the ſecond *Number* in the 1ſt operation, and either 100 or 12 (it matters not which) muſt be the firſt *Number*, but I will take 100, and then for the 3d *number*, I put that *number* in the Demand which hath the ſame denominat on w th 100, which is 75, (for they both ſignifie pounds principal) and then the *Numbers* will ſtand as you ſee in the margent.

100 — 6 — 75

But if I had for the firſt *number* put the other *number* in the Suppoſition *viz.* 12, which ſignifieth 12 Months, then the third

Number muſt have been 9, which is that *number* in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 Moneths, and then they will ſtand as you ſee in the Margent.

12 —— 6 —— 9

There yet Remains two *numbers* to be diſpoſed of, and thoſe are, one in the ſuppoſition, and another in the Demand, that which is of the ſuppoſition, I place under the firſt of the three *Numbers* and the other which is in the demand I place under the 3d *number*, and then 2 of the *terms* in the Suppoſition will ſtand (one over the other) in the firſt place, and the 2 *terms* in the Demand will ſtand (one over the other) in the third place, as in the margent.

100 —— 6 —— 75
12 9

or thus

12 — 6 — 9
100 75

8. Having diſpoſed, or ordered the *numbers* given according to the laſt Rule, we may proceed to a Reſolution, and firſt I work with the three uppermoſt *numbers* which according to the firſt diſpoſition are 100, 6, and 75, which is as much as to ſay, If 100 *l.* Require 6 *l.* (Intereſt) how much will 75 *l.* Require, which by the 3 Rule of the 11 Chapter I find to be *Direct*, and by the 7 and 8 Rules of the 10th.

Chap-

Chapter I find the 4th. *Proportional number*, to be 4 *l.* 10 *s.* ſo that by the foregoing *ſingle* queſtion I have diſcovered how much 75 *l.* will gain Intereſt in 12 M. the operation wherof followeth on the left hand under the Letter A; and having diſcovered how much 75 *l.* will gain in 12 Moneths, we may by another queſtion eaſily diſcover how much it will gain in 9 Moneths, for this 4th. *number* (thus found) I put in the middle between the two loweſt *numbers* of the five, after they are p'aced according to the 7th. Rule of this Chapter; and then it will be a ſecond *number*. In another Queſtion in the Rule of 3, the *numbers* being

12 —— 4 l. —— 10 s. —— 9

the firſt and third *numbers* being of one denomination, *viz.* both Moneths, and may be thus expreſſed. If 12 Months Require 4 *l.* 10 *s.* Intereſt, what will 9 Months Require? and by the 3 Rule of the 11 Chapter; I find it to be the *Direct* Rule, and by working according to the directions laid down in the 7, 8, and 9 Rules of the 10th. Chapter, I find the 4th. *Proportional number* to the laſt ſingle Queſtion to be 3 *l.* 07 *s.* 06. which is the ſixth *Proportional number* to the 5 given *numbers* and is the Anſwer to the General Queſtion. The work of the laſt ſingle Queſtion is expreſſed on the Right ſide of the page

under the letter B as followeth.

100 —— 6 —— 75

A			B			
	12			9		
l.	l.	l.		then say		
If 100	—— 6	—— 75	*If* 12	—— 4	—— 10	—— 9
	75			20		
	—			—		
	30			90	*shillings*	
	42			12		
	——	l. s.		——		
1100)	4150	(4 — 10		180		
	4			90		
	——			——		
Remains	(50)			1080	*pence*	
Multiply	20			9		
	——			——	12)	210 *l. s. d.*
1100)	10100	(10 *s.*	12)	9720	(810 (617 (3-7-6	
		l. s.		..	.	
facit		4 — 10		96	72	
				——	——	
				12	90	
				12	84	
				——	——	
				(0)	(6)	*pence*
				l.	s.	d.
			facit	3	—— 7	—— 6

So that by the foregoing operation I conclude that If 100 *l.* in 12 Months gain 6 *l.* Interest, 75 *l.* will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months, after the same Rate.

The

The Anſwer would have been the ſame, if the 5 given *numbers* had been ordered according to the ſecond method, *viz.* as you ſee in the margent.

12	6	9
100		75

For firſt I ſay, If 12 Months gain 6 *l.* what will 9 Months gain, this Queſtion I find to be *Direct* by the 3 Rule of the 11th. Chapter, and by the 7 and 8 Rules of the 10th. Chapter, I find the fourth *Proportional number* to theſe three to be 4 *l.* 10 *s.*

Thus have I found out what is the Intereſt of 100 *l.* for 9 Months, and I have now to find the Intereſt of 75 *l.* for 9 Months; to effect which, I make this 4th. *number* (found as before) to be my ſecond *number* in the next Queſtion, and ſay, If 100 *l.* Require 4 *l.* 10 *s.* what will 75 *l.* Require, this Queſtion I find (by the ſaid 3 Rule of the 11th. Chapter) to be *Direct*, and by the ſaid 7, 8, and 9 Rules of the 10th Chapter, I find the Anſwer to be as before *viz.* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been ſufficiently explained by the foregoing Example, ſo that the Learner may be able to Reſolve the following (or any other) queſtions pertinent to the double Rule of 3 *Direct*, whoſe anſwers are there given, but the operation

purposely omitted to try the Learners ability in the knowledge of what hath been before delivered.

Queſt. 2. A ſecond Example in this Rule may be as followeth, *viz.* A Carrier Receiveth 42 ſhillings for the Carriage of 3 *C.* weight 150 Miles, I demand how much he ought to Receive for the Carriage of 7 *C.* 3 *qrs.* 14 *l.* 50 Miles at that Rate? Anſwer 36 *s.* 9 *d.*

Queſt. 3. A Regiment of 936 Souldiers eat up 351 quarters of wheat in 168 days, I demand how many quarters of wheat 11232 Souldiers will eat in 56 days at that Rate? Anſwer 1404 *qrs.*

Queſt. 4. If 40 Acres of Graſs be mowed by 8 men in 7 days, how many Acres ſhall be mowed by 24 men in 28 days? Anſwer, 480 Acres.

Queſt. 5. If 48 Buſhels of Corn (or other ſeed) yield 576 Buſhels in 1 year, how much will 240 Buſhels yield in 6 years at that Rate? that is to ſay, if there were ſowed 240 Buſhels every one of the 6 years? Anſwer 17280 Buſhels.

Queſt. 6. If 40 ſhillings is the wages of 8 men for 5 dayes, what ſhall be the wages of 32 men for 24 days? Anſwer 768 ſhillings, or 38 *l.* 8 *s.*

Queſt. 7. If 14 Horſes eat 56 buſhels of

of provender in 16 dayes, how many Bushels will 20 horses eat in 24 dayes? Answer 120 Bushels.

Quest. 8. If 8 Cannons in 1 day spend 48 barrels of Powder, I demand how many barrels 24 Cannons will spend is 12 days at that Rate? Answer, 1728 *barrels.*

Quest. 9. If in a Family consisting of 7 Persons, there are drank out 2 *Kilderkins* of *beer* in 12 dayes, how many *Kilderkins* will there be drank out in 8 dayes, by another Family consisting of 14 persons? Answer 48 Gallons, or 2 Kilderkins and 12 Gallons.

Quest. 10. A *Usurer* put 75 *l.* out to Receive Interest for the same, and when it had continued 9 Months, he Received for Principal and Interest 78 *l.* 7 *s.* 6 *d.* I demand at what Rate *per Cent. per annum*, he Received Interest? Answer, at 6 *l. per Cent. per annum.*

CHAP.

CHAP. XIII.

The Double Rule of three Inverſe.

1. The Double Rule of 3 *Inverſe*, is when a queſtion in the Double Rule of 3 is Reſolved by 2 Single Rules of 3, and one of thoſe Single Rules falls out to be *Inverſe*, or requires a 4th. *number* in *Proportion Reciprocal*, (for both the queſtions are never *Inverſe*.)

2. In all queſtions of the Double Rule of 3 (as well *Inverſe* as *Direct*) you are (in the diſpoſing of the 5 given *numbers*) to obſerve the 7th. Rule of the 12 Chapter, and in reſolving of it by two ſingle Rules, obſerve to make choice of your *Numbers* for the firſt, and ſecond, ſingle queſtions, according to the directions given in 8 Rule of the ſame Chapter, as in the Example following, *viz.*

Queſt. 1. If 100 *l.* Principal in 12 months gain 6 *l.* Intereſt, what Principal will gain

gain 3 *l.* 7 *s.* 6 *d.* in 9 Months?

This Queſtion is an Inverſion of the firſt queſtion of the 12 Chapter, and may ſerve for a proof thereof.

In order to a Reſolution, I diſpoſe of the 5 given *numbers* according to the 7th. Rule of the laſt Chapter, and being ſo diſpoſed will ſtand as followeth.

12 ——— 100 ——— 9

	l.	s.	d.
6	3	7	6

Or thus

		l.	s.	d.
6 ———	100 ———	3	7	6
12		9		

Here obſerve, that according to the 8th. Rule of the 12 Chapter, the firſt queſtion (if you take it from the 5 *numbers* as they are ordered or placed firſt) will be, If 12 Months Require 100 *l.* Principal, what will 9 Months Require? (to make the ſame Intereſt) this (according to the 3 Rule of the 11 Chapter) is *Inverſe*, and the Anſwer will be found (by the 2 Rule of the 11th. Chapter) to be 133 *l.* 6 *s.* 8 *d.* the ſecond queſtion then will be, If 6 *l.* Intereſt, Require 133 *l.* 6 *s.* 8 *d.* Principal, how

how much Principal will 3 *l.* 7 *s.* 6 *d.* require, this is a direct Rule. and the Answer in a direct *Proportion* is 75 *l.* See the work.

first I say

m. *l.* *m.*

If 12 — 100 — 9

12

— l. s.d.

9) 1200 (133-6-8

9 s. d.

facit 133-6-8

30

27

30

27

(3)

20

9) 60 (6 *s.*

54

(6)

12

9) 72 (8 *d.*

72

(0)

then

then I say

	l.		l.	s.	d		l.	s.	d.
If	6	——	133	— 6	— 8	——	3	— 7	— 6
	240		20				20		
1440 *d.*			2666				67		
			12				12		
			5340				140		
			2666				67		
			32000				810 *d.*		
			810						
			320000						
			256						

1440) 259200010 (18000 *d.* or 75 *l.*

144

1152

1152

(0)

So that by the foregoing work I find that if 6 *l.* Interest be gained by 100 *l.* in 12 Months, 3 *l.* 7 *s.* 6 *d.* will be gained by 75 *l.* in 9 Months.

But if the Resolution had been found out by the *numbers* as they are Ranked in the second place, then the second question in the single Rule would have been *Inverse*, and

and the first Question *Direct*, and the conclusion the same with the first method; *viz.* 75 *l.*

Quest. 2. If a Regiment consisting of 936 Soldiers can eat up 351 quarters of wheat in 168 dayes, how many Soldiers will eat up 1404 quarters in 56 dayes at that Rate? *Answer*, 11232 Soldiers.

Quest. 3. If 12 Students in 8 weeks spend 48 *l.* I demand how many Students will spend 288 *l.* in 18 weeks? *Answer*, 32 Students.

Quest. 4. If 48 *l.* serve 12 Students 8 weeks, how many weeks will 288 *l.* serve 4 Students? *Answer*, 144 weeks.

Quest. 5. If when the Bushel of wheat cost 3 *s.* 4 *d.* the peny Loaf weigheth 12 ounces, I demand the weight of the Loaf worth 9 pence when the Bushel cost 10 *s.*? *Answer*, 3 *l.* or 36 ounces.

Quest. 6. If 48 pioneers in 12 days, cast a Trench 24 *yards* long, how many pioneers will cast a Trench 168 *yards* long in 16 days? *Answer*, 252 pioneers.

Quest. 7. If 12 *C.* weight being Carried 100 miles cost 5 *l.* 12 *s.* I desire to know how many *C.* may be carried 150 miles at that Rate? *Answer*, 18 *C.*

Quest. 8. If when wine is worth 30 *l.* *per Tun*, 20 pounds worth is sufficient for the

the ordinary of 100 men, how many men will 4 *l.* worth suffice when it is worth 24 *l.* per Tun? *Answer* 25 men.

Quest. 9. If 6 men in 24 days mow 72 Acres in how many days will 8 men mow 24 Acres? *Answer* in 6 days.

Quest. 10. If when the Tun of wine is worth 30 *l.* 100 men will be satisfied with 20 *l.* worth, I desire to know what the Tun is worth when 4 *l.* worth will satisfie 25 men at the same Rate? *Answer* 24 *l.* per Tun.

CHAP. XIV.

The Rule of three Composed of 5 Numbers.

1. THE Rule of three Composed, is when questions (wherein there are 5 *Numbers* given to find a 6 in Proportion thereunto) are Resolved by one *single* Rule

Rule of 3 Compoſed of the 5 given *Numbers.*

2. When queſtions may be performed by the double Rule of 3 *Direct*, and it required to reſolve them by the Rule of 3 *Compoſed*, (firſt *Order* or *Rank* your *Numbers* according to the 7 Rule of the 12th. Chapter, then)

The Rule is

Multiply the *terms* (or *numbers*) that ſtand one over the other in the firſt place, the one by the other, and make their *Product* the firſt *term* in the Rule of 3 *Direct*, then Multiply the *terms* that ſtand one over the other in the third place, and place their product for the third term in the Rule of 3 *Direct*, and put the middle *term* of the 3 uppermoſt for a ſecond *term*, then having found a fourth *Proportional*, direct to theſe 3, then this 4th. *Proportional* ſo found, ſhall be the Anſwer *Required.*

So the firſt queſtion of the 12 Chap. (*viz.* If 100 *l.* in 12 Months gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months? the *numbers* being *Ranked* (or placed) as is there *Directed* and done.

Then I multiply the 2 firſt *terms* 100 and 12, the one by the other, and their *Product* is 1200 (for the firſt *term*) then I multiply the two laſt *terms* 75 and 9 toge-

ther,

ther, and their *Product* is 675 for the 3d. *term*. Then I ſay, As 1200 is to 6, ſo is 675 to the Anſwer, which by the Rule of 3 *Direct* will be found to be 3 *l.* 7 *s.* 6 *d.* as before.

3. But if the Queſtion be to be Anſwered by the double Rule of 3 *Inverſe*, then (having placed the 5 given *terms* as before) multiply the lowermoſt *term* of the *firſt* place, by the uppermoſt *term* of the *third* place, and put the *Product* for the *firſt term*; then multiply the uppermoſt *term* of the *firſt* place, by the lowermoſt *term* of the *third* place, and put the *Product* for the *third term*, and put the *ſecond term* of the 3 higheſt *numbers* for the middle *term* to thoſe two, then if the Inverſe *Proportion* is found in the uppermoſt 3 *numbers*, the 4th. *Proportional* direct to theſe 3 ſhall be the Anſwer; ſo the firſt queſtion of the 13th. Chapt. being ſtated, *viz.* If 100 *l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months? State the *numbers* as is there Directed in the firſt order, *viz.*

M.	l.	M.
12	100	9
l.		l. s. d.
6		3—7—6

then

then Reduce the 6 *l.* and 3 *l.* 7 *s.* 6 *d.* into pence, the 6 *l.* is 1440 *d.* and 3 *l.* 7 *s.* 6 *d.* is 810 *d.* then multiply 1440 by 9, the product is 12960 for the first *term* in the Rule of 3 *Direct*, and multiply 810 by 12, the product is 9720 for the third *term*, then I say, As 12960 is to 100 *l.* so is 9720 to the Answer, *viz.* 75 *l.* as before. But if the *terms* had been placed after the second order, *viz.*

l.	l.	l.	s.	d.
6	100	3	7	6
M.		M.		
12		9		

then the *Inverse* Proportion is found in the lowest *numbers*, and having composed the *numbers* for a single Rule of 3 as in the second Rule foregoing, then the Answer must be found by a single Rule of 3 *Inverse*, for here it falls out to multiply 810 by 12 for the first *number*, and 1440 by 9 for the third *number*, and then must say, As 9720 is to 100 *l.* so is 12960 to the Answer, which by *Inverse Proportion* will be found to be 75 *l.* as before.

The questions in the 12 and 13 Chapters may serve for thy further experience?

CHAP.

CHAP. XV.

Single Fellowſhip.

1. FELLOWSHIP is that Rule of Plural *Proportion*, whereby we ballance Accompts depending between divers Perſons having put together a general Stock, ſo that they may every man have his *Proportional* part of gain, or ſuſtain his *Proportional* part of loſs.

2. The Rule of Fellowſhip is either ſingle, or it is double.

3. The ſingle Rule is when the Stocks propounded are ſingle *numbers*, without any Reſpect or Relation to time.

4. In the ſingle Rule of Fellowſhip, the *Proportion* is, As the whole Stock of all the Partners, is in *Proportion* to the total Gain or Loſs, ſo is each mans particular ſhare in the Stock, to his particular ſhare in the Gain or Loſs. Therefore take the total of all the Stocks for the firſt *term* in the Rule of 3, and the whole Gain or Loſs for the ſecond *term*, and the particular Stock of any one

one of the partners for the third *term*, then Multiply and Divide according to the 7 Rule of the 9th. Chapter, and the 4th. *Proportional number* is the particular Loss or Gain of him whose Stock you made your second *number*, wherefore repeat the Rule of 3 as often as there are particular Stocks, or Partners in the question, and the 4th. *terms* produced upon the several operations, are the Respective Gain or Loss of those particular Stocks given, as in the Examples following.

Quest. 1. Two Persons, *viz.* A and B bought a tun of wine, for 20 *l.* of which A paid 12 *l.* and B paid 8 *l.* and they gained in the Sale thereof 5 *l.* now I demand each mans share in the Gains according to his Stock?

First I find the sum of their Stocks, by adding them together, *viz.*

12 *l.* and 8 *l.* which are 20 *l.*	12
then according to this Rule	8
I say first, If 20 *l.* (the sum	———
of their Stocks) Require	20 *l.*
5 *l.* the total gain how	

much will 12 *l.* (the Stock of A) Require? Multiply and Divide by the seventh Rule of the ninth Chapter, and the

the Answer is 3 *l.* for the *share* of A in the *gains*; then again I say, If 20 *l.* Require 5 *l.* what will 8 *l.* Require? the *Answer* is 2 *l.* which is the *gain* of B. So I conclude that the *share* of A in the *gain* is 3 *l.* and the *share* of B in the gain is 2 *l.*

	l.	l.	l.
If	20	5	12

12

20) 60 (3 l.
60
(0)

	l.	l.	l.
If	20	5	8

8

20) 40 (2 l.

Quest. 2. Three Merchants, *viz.* A, B and C, enter a joynt Adventure; A, put into the the common stock 78 *l.* B, put in 117 *l.* and C, put in 234 *l.* and they find (when they make up their Accompts) that they have gained in all 264 *l.* now I desire to know each mans *particular share* in the gains?

First I add their *Particular* stocks together, and their sum is 429 *l.* then say, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? and what 117 *l.* and what will 234 *l.* (the stocks of A, B, and C) gain? work by 3 several Rules, of 3 and you will find that

	l.
	78
	117
	234
Sum	429

		l.
The gain of	A	48
	B	72
	C	144
	Sum	264

Queſt. 3. Four Partners, *viz.* A, B, C, and D, between them build a Ship, which coſt 1730 *l.* of which A paid 346 *l.* B 519 *l.* C 692 *l.* and D 173 *l.* and her Freight for a certain Voyage is 370 *l.* which is due to the Owners, or builders, I demand each mans *ſhare* therein according to his charge in building her?

Anſwer

	l.
A	74
B	111
C	148
D	37
Sum	370

Queſt. 4. A, B, and C, enter *Partnerſhip* for a certain time, A put into the common ſtock 364 *l.* B put in 482 *l.* C put in 500 *l.* and they gained 867 *l.* now I demand

mand each mans *ſhare* in the gain, *Proportionable* to his Stock?

Anſwer.

	l.	s.	d.
A	234	09	$3\frac{154}{175}$
B	310	09	$5\frac{6}{175}$
C	322	01	$3\frac{90}{175}$
Sum	867	00	0

5. To prove the Rule of *Single Fellowſhip*, add each mans *Particular* gains or loſs together, and if the ſum total is equal to the general gain or loſs, then is the work Rightly perfomed, but otherwiſe it is erroneous. Example in the firſt queſtion of this Chapter, the *Anſwer* was that the gain of A was 3 *l.* and the gain of B 2 *l.* which added together make 5 *l.* equal to the total gain given.

The proof of the Rule of Single Fellowſhip.

If in finding out the *Particular ſhares* of the ſeveral *Partners*, any thing Remain after Diviſion is ended, ſuch Remainders muſt be added together (they being all Fractions of the ſame denomination) and their ſum divide by the Common diviſor in

each queſtion (*viz.* the total ſtock) and the Quotient add to the *Particular gains*, and then if the Total ſum is equal to the total gain the work is Right otherwiſe not.

As in the laſt queſtion, the Remainders were 354, 62, and 930 which added together make 1346 which divided by 1346 (the ſum of their Stocks) the quotient is 1 *d.* which I add to the pence *&c.* and the ſum of their ſhares is 867 equal to the Total gain; wherefore the work is Right.

CHAP. XVI.

Double Fellowſhip.

1. DOUBLE Fellowſhip, is when ſeveral perſons enter into *Partnerſhip* for unequal time, that is, when every mans *Particular* ſtock hath Relation to a *Particular* time.

2. In the Double Rule of Fellowſhip, multiply each *Particular* ſtock by its Reſpective

ſpective time, and having added the ſeveral products together make the r ſum the firſt *number* (or *term*) in the Rule of 3, and the Total gain or loſs the ſecond number, and the Product of any ones particular ſtock by his time, the third *term* and the 4th *number* in *Proportion* thereunto is his *Particular* gain or loſs, whoſe Product of ſtock and time is your third *number*.

Then Repeat (as in ſingle Fellowſhip) the Rule of 3 as often as there are products (or partners) and the 4th. *terms* Invented are the *numbers* Required. Example.

Queſt. 1. *A* and *B* enter *Partnerſhip*, *A* put in 40 *l.* for 3 moneths, *B* put in 75 *l.* for 4 Moneths, and they gained 70 *l.* now I demand each mans *ſhare* in the gains, proportionable to his ſtock and time? *Anſwer* A 20 *l.* B 50 *l.*

To Reſolve this queſtion I firſt multiply the ſtock of A (*viz.* 40 *l.*) by its time (3 Moneths) the product is 120, then I multiply the ſtock of B by its time (*viz.* 75 by 4) and it produceth 300, which I add to the Product of *A* his ſtock and time, the ſum is 420. Then by the Rule of 3 I

	l.		l.
	40		75
	3		4
A	120	B	300
			120
		Sum	420

ſay; As 420 (the ſum of the products is to 70 (the total gain) ſo is 120 (the product of A his Stock and time) to 20 *l.* the *ſhare* of A in the gains. Then I ſay again, As 420 is to 70, ſo is 300 to 50 *l.* the *ſhare* of B in the gains.

Queſt. 2. A, B, and C, make a Stock for 12 Moneths, A put in at firſt 364 *l.* and 4 Moneths after that he put in 40 *l.* B put in at firſt 408 *l.* and at the end of 7 Moneths he took out 86 *l.* C put in at firſt 148 *l.* and 3 Moneths after he put in 86 *l.* more, and 5 M. after that he put in 100 *l.* more, and at the end of 12 Moneths their gain is found to be 1436 *l.* I deſire to know each mans *ſhare* in the gains according to his ſtock and his time?

Firſt I conſider, that the whole time of their *Partnerſhip* is 12 Moneths. Then I proceed to find out the ſeveral products of ſtock and time as followeth.

A, had at first 364 *l.* for 4 Moneths wherefore their product is	1456
Then he put in 40 *l.* which with the first sum makes 404 *l.* which continued the Remainder of the time, *viz.* 8 Months, and their product is	3232
The sum of the products of the stock and time of A is	4688
B, had 408 *l.* in 7 Moneths whose product is	2856
And then took out 86 *l.*, therefore he left in Stock 322 *l.* which Continued the Rest of the time *viz.* 5 Months, whose product is	1610
The Sum of the Products of the stock and time of B is	4466
C, put in 148 *l.* for 3 Mon. whose product being multiplyed, is	444
Then he put in 86 *l.* which added to the first (*viz.* 148) makes 234 *l.* which lay in stock 5 mon. their product is	1170

Then he put in 100 *l.* more, ſo then he had in ſtock 334 *l.* which continued the Remainder of the time (*viz.* 4 months) which multiplyed together produce 1336

The ſum of the product of the money and time of C is 2950

B 4466

A 4688

The Total ſum of all the product is 12104

Then I ſay, As 12104 is to 1436 (the total gain) ſo is 2950 to the *ſhare* of A in the gains, *&c.* go on as in the foregoing Examples, and you will find their ſhares in the gain to be as followeth, *viz.*

Anſwer.

			l.	s.	d.
The *ſhare* of	A	is	556	03	6 $\frac{6192}{12104}$
	B		529	16	9 $\frac{5496}{12104}$
	C		349	19	8 $\frac{416}{12104}$
			1436	00	0

Queſt. 3. Three Graſiers *A*, *B*, and *C*, Take a piece of Ground for 46 *l.* 10 *s.* in which A put 12 Oxen for 8 moneths, *B* put in 16 Oxen for 5 moneths, and *C* put

put 18 Oxen for 4 moneths, now the queſtion is, what ſhall each man pay of the 46 *l.* 10 *s.* for the Ground?

Anſwer.

		l.	*s.*
A	ſhall pay	18	—00
B		15	—00
C		13	—10
		46	—10

3. The Proof of this Rule is the ſame with that of *Single Fellowſhip*, laid down in the 5th. Rule of the 15th. Chapter, and note that

If a loſs be ſuſtained inſtead of gain amongſt *Partners*, every mans ſhare to be be born in the loſs, is to be found after the ſame method as their gain, whether their ſtocks be for equal or unequal time.

CHAP. XVII.

Allegation Medial.

1. THE Rule of Allegation is that Rule in Plural proportion, by which we Resolve questions, wherein is a composition or mixture of diverse simples, as also it is useful in the Composition of medicines both for quantity, quallity, and price. And its species are two, *viz.* Medial and Alternate.

2. Alligation Medial is when having the several quantities, and prises of several simples propounded we discover the mean price, or Rate of any quantity of the mixture compounded of those simples and the proportion is

As the sum of the simples to be mingled is to the Total value of all the simples, so is any part, or quantity of the Composition or mixture, to its mean Rate or Price.

Quest. 1. A Farmer mingleth 20 bushels of wheat at 5 *s. per* bushel and 36 bushels of Rye at 3 *s. per* bushel, with 40 bushels

bushels of barley at 2 *s. per* bushel, now I desire to know what one bushel of that mixture is worth?

To Resolve this question, add together the given quantities and also their values, which is 96 bushels, whose total value is 14 *l.* 8 *s.* as appeareth by the work following, for

bush.		l.	s.
20	*of wheat at* 5 s. *per bush. is*	05	00
36	*of Rye at* 3 s. *per bush. is*	05	08
40	*of barley at* 2 s. *per bush. is*	04	00
The sum of the given quantities is	96 *and their value is*	14	08

Then say by the Rule of 3 *Direct.*

If 96 *Bushels* cost (or is worth) 14 *l.* 8 *s.* what is 1 *Bushel* worth?

b.	l.	s.	b.
96	14	8	1

20

96) 288 (3 s.

288 *facit* 3 s. *per bushel.*

(0)

Quest 2. A Vintner mingleth 15 gallons of Canary at 8 s. *per* gallon with 20 gallons of Malligo at 7 *s.* 4 *d.* *per* gallon, with 10

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2. Alligation Medial is when having the ſeveral quantities, and priſes of ſeveral ſimples propounded we diſcover the mean price, or Rate of any quantity of the mixture compounded of thoſe ſimples and the proportion is

As the ſum of the ſimples to be mingled is to the Total value of all the ſimples, ſo is any part, or quantity of the Compoſition or mixture, to its mean Rate or Price.

Queſt. 1. A Farmer mingleth 20 buſhels of wheat at 5 *s. per* buſhel and 36 buſhels of Rye at 3 *s. per* buſhel, with 40 buſhels

bushels of barley at 2 *s. per* bushel, now I desire to know what one bushel of that mixture is worth?

To Resolve this question, add together the given quantities and also their values, which is 96 bushels, whose total value is 14 *l.* 8 *s.* as appeareth by the work following, for

bush.		l.	s.
20	*of wheat at* 5 s. *per bush. is*	05	00
36	*of Rye at* 3 s. *per bush. is*	05	08
40	*of barley at* 2 s. *per bush. is*	04	00
The sum of the given quantities is	96 *and their value is*	14	08

Then say by the Rule of 3 *Direct.*

If 96 *Bushels* cost (or is worth) 14 *l.* 8 *s.* what is 1 *Bushel* worth?

b.	l.	s.	b.
96	14	8	1

20

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288

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2. Alligation Medial is when having the ſeveral quantities, and priſes of ſeveral ſimples propounded we diſcover the mean price, or Rate of any quantity of the mixture compounded of thoſe ſimples and the proportion is

As the ſum of the ſimples to be mingled is to the Total value of all the ſimples, ſo is any part, or quantity of the Compoſition or mixture, to its mean Rate or Price.

Queſt. 1. A Farmer mingleth 20 buſhels of wheat at 5 *s. per* buſhel and 36 buſhels of Rye at 3 *s. per* buſhel, with 40 buſhels

buſhels of barley at 2 *s. per* buſhel, now I deſire to know what one buſhel of that mixture is worth?

To Reſolve this queſtion, add together the given quantities and alſo their values, which is 96 buſhels, whoſe total value is 14 *l.* 8 *s.* as appeareth by the work following, for

buſh.		l.	s.
20	*of wheat at* 5 s. *per buſh. is*	05	00
36	*of Rye at* 3 s. *per buſh. is*	05	08
40	*of barley at* 2 s. *per buſh. is*	04	00
The ſum of the given quantities is 96	*and their value is*	14	08

Then ſay by the Rule of 3 *Direct.*

If 96 *Buſhels* coſt (or is worth) 14 *l.* 8 *s.* what is 1 *Buſhel* worth?

b.	l.	s.	b.
96	14	8	1

20

96) 288 (3 s.

288

(0)

facit 3 s. *per buſhel.*

Queſt 2. A Vintner mingleth 15 gallons of Canary at 8 s. *per* gallon with 20 gallons of Malligo at 7 *s.* 4 *d.* *per* gallon, with 10

gallons of Sherry at 6 *s.* 8 *d. per* gallon, and 24 gallons of white wine at 4 *s. per* gallon, now I demand what a gallon of that mixture is worth? work as in the laſt Queſt. and you will finde the Anſwer to be 6 *s.* 2 *d.* 2 *qrs.* $\frac{4}{69}$.

Queſt. 3. A Grocer hath mingled 3 C. of Sugar at 56 *s. per C.* with 4 *C.* of the Sugar at 3 *l.* 14 *s.* 8 *d. per C.* and with 6 *C.* at 1 *l.* 17 *s.* 4 *d. per C.* I deſire to know the price of a hundred weight of that mixture? *Anſwer.* 2 *l.* 13 *s.* 1 *d.* $\frac{7}{13}$.

The proof of Alleg. Medial.

3. The proof of this operation is by the price of any quantity of the mixture to finde out the total value of the whole compoſition, and if it is equal to the total value of the ſeveral ſimples, the work is right, otherwiſe not. As in the firſt example, the Anſwer to the queſt. was that 3 *s.* is the price of one buſhel, wherefore I ſay by the rule of proportion, If 1 buſhel be 3 ſhillings, what is 96 buſhels. *Anſw.* 14 *l.* 8 *s* which is the total value of the ſeveral ſimples, wherefore the work is right.

Chap.

CHAP. XVIII.

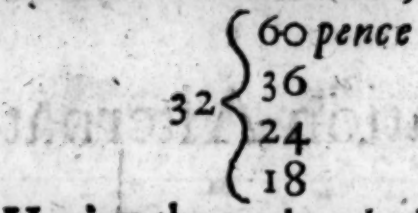
Allegation Alternate.

1. ALlegation alternate is when there are given the particular priſes of ſeveral ſimples, and thereby we diſcover ſuch quantities of thoſe ſimples, as being mingled together ſhall bear a certain rate propounded.

2. When ſuch a queſtion is ſtated, place the given priſes of the ſimples one over the other, and the propounded price of the Compoſition againſt them in ſuch ſort that it may repreſent a root and they ſo many branches ſpringing from it as in the following example.

Queſt. 1. A certain Farmer is deſirous to mix 20 buſhels of wheat at 5 s. or 60 d. *per* buſhel with rye at 3 s. or 36 d. *per* buſh. and with Barly at 2 s. or 24 d. *per* buſhel, and Oats at 1 s. 6 d. *per* buſhel, and deſireth to mix ſuch a quantity of Rye, Barly and Oats with the 20 buſhels of wheat as that the whole compoſition may be worth 2 s. 8 d. or 32 d. *per* buſhel. The

The prises of the simples being placed according to the last rule, with the price of the composition propounded as a root to them will stand as followeth,

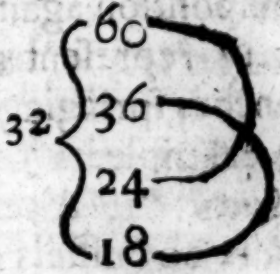


3. Having thus placed the given numbers you are to link or combine the several rates of the simples the one to the other, by certain arches in such sort that one that is lesser then the root, (or mean rate) may be linked or coupled to another that is greater then the mean rate, so the question last propounded will stand,

1 thus,

2 or thus

3 or thus.



4. Then

4. Then take the difference between the root and the ſeveral branches, and place that difference againſt the number or branch, with which it is coupled, or linked, and having taken all the differences and placed them as aforeſaid, then thoſe differences ſo placed, will ſhew you the number of each ſimple to be taken to make a compoſition to bear the mean rate propounded.

So the branches of the laſt queſtion being linked together as in the firſt manner, I ſay the difference between 32 and 60 is 28 which I put againſt 18 becauſe 60 is linked with 18, then the difference between 32 and 36 is 4 which, I put againſt 24 becauſe 36 is linked or coupled with 24, then I ſay the difference between 32 and 24 is 8 which I place againſt 36 (for the reaſon aforeſaid) then I ſay the difference between 32 and 18 is 14 which I place againſt 60; and then the work will ſtand as you ſee in the margent.

So I conclude that a compoſition made of 14 buſhels of wheat at 60 d. *per* buſhel, and 8 buſhel of Rye at 36 d. *per* buſhel and 4 buſhels

4 bushels of Barly at 24 d. *per* bushel, and 28 bushels of Oats at 18 d. *per* bushel, will bear the mean price of 32 d. or 2 s. 8 d. *per* bushel. And here observe that in this composition there is but 14 bushels of wheat, but I would mingle 20 bushels, and this kind (or rather case) of Allegation alternate (*viz.* when there is given a certain quantity of one of the simples, and the quantities of the rest sought to mingle with this given quantity that the whole may bear a price propounded) is called alternation partial.

And the proportion to find out the several quantities to be mingled with the given quantity is as followeth, *viz.*

As the difference annexed to the branch that is the vallue of an integer of the given quantity is to the other particular differences, so is the quantity given, to the several quantities required.

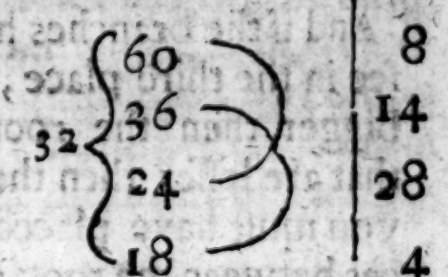
So here, to find out how much Rye, barly, and Oats must be mingled with the 20 bushels of wheat, I say by the single rule of three direct, if 14 bushels of wheat require 8 bushels of Rye, what will 20 bush. of wheat require? answer $11\frac{6}{14}$ bushels of rye.

Again, if 14 bushels of wheat require 4 bushels of barly what will 20 bushels of wheat

wheat require? anſwer $5\frac{10}{14}$ buſhels of barly. Again, I ſay, if 14 buſhels of wheat require 28 buſhels of Oats, what will 20 buſhels of wheat require? anſwer 40 buſhels of barly.

And now I ſay that 20 buſhels of wheat mingled with $11\frac{6}{14}$ buſhels of rye, and $5\frac{10}{14}$ buſhels of barly, and 40 buſhels of oates each bearing the rates aforeſaid, will make a compoſition or heap of Corn that may yeild 32 d. *per* buſhel.

But if the branches had been coupled according to the ſecond order, or manner, then the differences would have been thus placed, *viz.* the differences between 32 and 60 is 28 which I ſet againſt 24 becauſe 60 is linked thereto, and the difference between 32 and 36 is 4 which I ſet againſt 18, and the difference between 32 and 24 is 8, which I ſet againſt 60, then the difference between 32 and 18 is 14 which I ſet againſt his yoke-fellow 36, and then I conclude that if you mix 8 buſhels of wheat with 14 buſhels of Rye, 28 buſhels of barly, and 4 buſhels of oats each bearing the foreſaid priſes the whole mixture



ture may be ſold for 32 d. *per* buſhel as by the work in the margent.

You ſee by this work we have found how many buſhels of rye, barly, and oats, ought to be mixed with 8 buſhels of wheat, and to find out how many of each ought to to be mixed with 20 buſhel of wheat I ſay,
As 8 is to 14 ſo is 20 to 35 buſhels of rye.
As 8 is to 28 ſo is 20 to 70 buſhels of barly.
As 8 is to 4 ſo is 20 to 10 buſhels of oates.
whereby I conclude that if to 20 buſhels of wheat I put 35 buſhels of rye, 70 buſhels of barly, and 10 buſhels of oats bearing each the foreſaid priſes *per* buſh. that thena buſh. of this mixture will be worth 32 d. or 2s. 8d.

And if the branches had been linked as you ſee in the third place, where each branch bigger then the root, is linked to two that are leſſer then the root, then in this caſe you muſt have placed the ſeveral differences between the root and branches, againſt thoſe 2 with which each is coupled, as firſt the difference between 32 and 60 is 28 which I Put againſt 24 and 18 becauſe it is

8, 14	22
8, 14	22
28, 4	32
28, 4,	32

cou-

coupled with them both, then the difference between 32 and 36 is 4 which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to to them both then the differenee between 32 and 24 is 8 which I put againſt 60 and 36 becauſe 24 is linked to them both, then the difference between 32 and 18 is 14 which I put againſt 60 and 36 the yoke fellows of 18.

Laſtly, I draw a line behind the differences and add the differences which ſtand againſt each branch and put the ſum behind the ſaid line againſt its proper branch as you ſee in the margent.

And now by this work I find that 22 buſhels of wheat mingled with 22 buſhels of rye, and 32 buſhels of barly, and 32 buſhels of oats each bearing the ſaid price will make a mixture bearing the mean rate of 32 d. *per* buſhel.

And to find how much of each of the reſt muſt be mingled with 20 buſhels of wheat I ſay

As 22 is to 22 ſo is 20 to 20 buſh. of rye.

As 22 is to 32 ſo is 20 to $29\frac{2}{22}$ buſh. of barly. As 22 is to 32 ſo is 20 to $29\frac{2}{32}$ buſhels of Oats.

Whereby you ſee the queſtions of Allegation alternate will admit of more true anſwers then one for we have found 3 ſeveral anſwers

anſwers to this firſt queſtion.

Queſtion of alternation partial are proved the ſame way with queſtions in Allegation medial, which you may ſee in the 3 rule of the 17 Chap.

The proof of alternation partial.

Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz.* of 12 d. *per* l. of 10 d. per l. of 6 d. per l. and of 4 d. per l. and he would have a compoſition worth 8 d. per pound the whole quantity whereof ſhould contain 144 l. made of theſe 4 ſorts, I demand how much of each he muſt take?

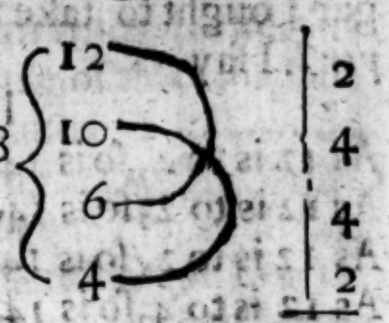
Queſtions of this nature are reſolved by that part of alligation alternate called by Arithmeticians alternation total, *viz.* where there is given the ſum, and priſes of ſeveral ſimples, to find out how much of each ſimple ought to be taken to make the ſaid ſum, or quantity, ſo that it may bear a certain rate propounded.

To reſolve this queſtion I place the ſeveral priſes of the ſimples, and mean rate propounded, and link them together as is directed in the 2 and 3 rules of this Chapter, and place the differences between the root and branches according to the 4 rule of this Chapter, which will then ſtand one of theſe 3 ways, *viz.*

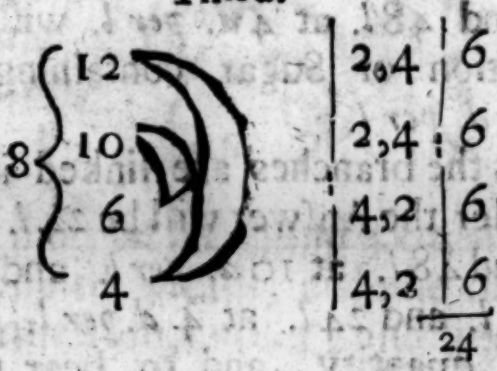
First

First,

Second.



Third.



5. Then adde the ſeveral differences together which I have done, and the ſums of the firſt and ſecond order are 12 l. and of the third 24 l. as you may ſee above, but it required that there ſhould be 144 l. of the compoſition, therefore to find the quantity of each ſimples to make the whole compoſition 144 l. obſerve this general rule, *viz.*

As the ſum of the differences, is to the ſeveral differences, ſo is the total quantity of the compoſition, to the quantity of each ſimple.

So

So to find how much of each ſort of Sugar I ought to take to make 144 *l.* at 8 *d. per l.* I ſay

I.

As 12 is to 4, ſo is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 6 *d. per l.*
As 12 is to 4, ſo is 144 to 48 *l.* at 4 *d. per l.*

Whereby I find that 48 *l.* at 12 *d. per l.* and 24 *l.* at 10 *d. per l.* and 24 *l.* at 6 *d per l.* and 48 *l.* at 4 *d. per l.* will make a compoſition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the branches are linked in the ſecond order, the Anſwer will be 24 *l.* at 12 *d. per l.* and 48 *l.* at 10 *d. per l.* and 48 *l.* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the ſaid quantity, and to bear the ſaid price.

And if you had worked as the branches are linked after the third order then you would have found the quantity of 36 *l.* of each.

Queſt. 3. A Vintner hath 4 ſorts of wine, *viz.* Canary at 10 *s. per* gallon, Mallaga at 8 s. *per* gallon; Rheniſh wine at 6 *s. per* gallon, and white wine at 4 *s. per* gallon; and he is minded to make a Compoſition of them all of 60 gallons that may be worth 5 ſhillings *per* gallon, I deſire to know how

how much of each he must have?

The numbers or terms being ranked according to the second Rule of this Chapter, the branches will be linked as followeth, and will admit of no other manner of coupling, because there is but one branch that is lesser then the Root, therefore all the rest must be linked unto it; and the differences between the Root and the three 1. branches, *viz.* 10, 8, and 6, which are 5, 3, and 1 must be set against 4 because they are all coupled with it, and the difference between the Root (*viz.* 5) and 4 which is 1 must be set against the 3 other because it is linked to them all, so I find 1 gallon of *Canary*, 1 gallon of *Mallaga*, 1 gallon of Rhenish wine, and 9 gallons of White-wine, prised as above, being mingled together will be worth 5 *s. per* gallon, the Sum being 12 gallons but there must be 60 gallons wherefore I say

As 12 is to 1, so is 60 to 5 gallons of Can.
As 12 is to 1, so is 60 to 5 gallons of Mall.
As 12 is to 1, so is 60 to 5 gallons of Rhen.
As 12 is to 9, so is 60 to 45 gallons of white wine.

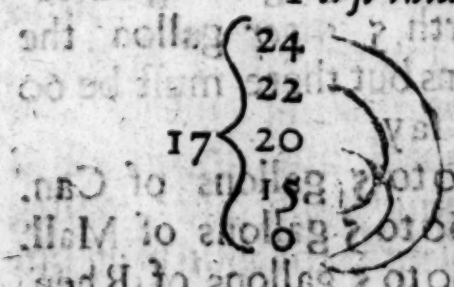
So

So that 5 gallons of Canary, 5 gallons of Malliga, 5 gallons of Rhenish, and 45 gallons of white wine mingled together, will be in all 60 gallons, worth 5 *s. per* gallon, which was Required.

Queſt. 4. A Goldſmith hath Gold of 4 ſeveral ſorts of fineſs, *viz.*, of 24 *Carects* fine, and of 22 *Carects* fine, of 20 *Carects* fine, and of 15 *Carects* fine. And he would mingle ſo much of each with alloy that the whole maſs of 28 ounces of gold ſo mingled may bear 17 *Carects* fine? the ſecond and third Rules of this Chapter being obſerved (for inſtead of the alloy I put 0 becauſe it bears no fineſs, but it makes a branch in the operation) the terms may be *Allegated* and the differences added any of theſe 4 wayes following.

Read Chap. 2. deff. 2. of this book.

First thus,



Secondly,

Secondly thus,

2	2
17	17
2, 17	19
7, 3,	10
5, 3	8
Sum	56

Thirdly thus,

2,	2
2,	2
2, 17	19
7, 5, 3,	15
3,	3
Sum	41

Fourthly thus,

2, 17,	19
2, 17,	19
2, 17,	19
7, 5, 3	15
7, 5, 3	15
Sum	87

More wayes may be given for the Allegating, or linking of the *terms* in this que-

ſtion, but theſe are ſufficient, and it ſhall alſo ſuffice to give an Anſwer to the queſtion as the *terms* are linked the firſt way, not doubting but the ingenious practitioner will be able at his leiſure, to find Anſwers to the other 3 wayes, *viz.*

	oz.	*p.w.*	*Car.*
As 56 is to 17, ſo is 28 to	8	10	of 24
As 56 is to 2 ſo is 28 to	1	00	of 22
As 56 is to 19, ſo is 28 to	9	10	of 20
As 56 is to 8, ſo is 28 to	4	00	of 15
As 56 is to 10, ſo is 28 to	5	00	of alloy.

Thus much well practiced and underſtood, is ſufficient for the underſtanding of Allegation.

The proof of Alternation Total.

In queſtions of Alternation Total, the Anſwer is given true, when the ſum of each of the quantity of ſimples found, agrees with the Sum or Quantity propounded; as in the laſt Queſtion, the Anſwer was 8 *oz.* 10 *p.w.* of 24 Carrects fine, 1 *oz.* of 22 Carrects fiue, 9 *oz.* 10 *p.w.* of 20 Carrects fine, 4 *oz.* of 15 Carrects fine, and 5 *oz.* of Alloy, which added together make 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHat a Vulgar fraction is, and its parts, and ſeveral kinds, hath been already ſhewed in the 19, 20, 21, 22, 23, 24 and 31 definitions of the firſt *Chapter* of this book, which the Learner is deſired diligently to obſerve before he proceed.

2. To Reduce a Vulgar fraction (which diſcovereth the Principal knowledge of fractions, and therefore ought greatly to be Regarded) we ſhall diſcover plainly under theſe 8 ſeveral heads (or Rules) following, *viz.*

1. To Reduce a mixt number into an improper Fraction.

2. To Reduce a whole number into an Improper Fraction.

3. To Reduce an Improper fraction into its equivalent whole (or mixt) number.

4. To Reduce a Fraction into its loweſt *terms* equivalent to the Fraction given.

5. To find the value of a Fraction in the known parts of Coin, Weight, Meaſure, *&c.*

6. To Reduce a Compound Fraction to a ſimple one of the ſame value.

7. To Reduce divers Fractions having unequal denominators, to fractions of the ſame value having equal denomination.

8. To Reduce a Fraction of one denomination to another of the ſame value.

I. To Reduce a mixt Number to an Improper fraction.

vide Chap. 1.
The Rule is *defin.* 31.

Multiply the Integral part (or whole Number) by the denominator of the Fraction, and to the product add the Numerator, and that ſum place over the denominator, ſo this new fraction ſhall be equal to the mixt number given. As for Example

I. Re-

1. Reduce $18\frac{3}{7}$ into an improper *fraction*, multiply the whole number 18 by 7 the *denominator*, and to the product add the *numerator* 3 the ſum is 129 which put over the *denominator* 7 and it makes $\frac{129}{7}$ for the anſwer as *per margent*.

$18\frac{3}{7}$
7
129
facit $\frac{129}{7}$

2. Reduce $183\frac{5}{12}$ to an improper *fraction facit* $\frac{2201}{12}$.

3. Reduce $56\frac{13}{21}$ to an improper *fraction facit* $\frac{1189}{21}$.

II. *To Reduce a whole number to an Improper fraction.*

The Rule is

Multiply the given *number*, by the intended *denominator* and place the product for a *numerator* over it, as *for example*. *Vide Ch.* 1. *defin.* 23.

1. Let it be required to reduce 15 into a fraction whoſe denominator ſhall be 12.

To effect which I multiply 15 by the intended denominator (12) the product is 180 which I place over 12 as a numerator and it makes $\frac{180}{12}$ which is equal to 15 which was required as *per* margent.

15
12
---
facit 180 30
12 15

180

2. Reduce 36 into an improper fraction whose denominator shall be 26 *facit* $\frac{936}{26}$.

3. Reduce 135 into an improper fraction whose denominator shall be 16 *facit* $\frac{2160}{16}$.

III. To Reduce an improper fraction into its equivalent, whole or mixt number.

The rule is,

Divide the numerator by the denominator, and the quotient is the whole number equal to the given fraction, and if any thing remain put it for a numerator over the divisor, example.

1. *Re-*

1. Reduce $\frac{436}{8}$ into its equivalent mixt number, divide the numerator 436 by the denominator 8 and the quotient is 54 and 4 remains which put for a numerator, over the diviſor 8 the anſwer $54\frac{4}{8}$ as *per margent.*

facit $54\frac{4}{8}$

8) 436 (54
40
36
32
4

2. Reduce $\frac{347}{15}\frac{6}{5}$ to a mixt number, *facit* $231\frac{11}{15}$.

3. Reduce $\frac{15576}{1336}$ to a mixt *number*, *facit* $114\frac{72}{1336}$.

IIII. To Reduce a fraction into its loweſt terms equivalent to the fraction given.

The Rule is.

1. If the *numerator* and *denominator* are even numbers take $\frac{1}{2}$ of the one and half of the other as often as may be and when either of them falls out to be an odd number, then divide them by any number that you can diſcover will divide both *numerator* and *denominator* without any remainder; and when you have thus proceeded as low as you can reduce them, then this new fraction ſo found out ſhall be the *fraction* you deſire, and will be in vallue equal

to the given *fraction*, example.

1. Let it be required to reduce $\frac{192}{336}$ into its loweſt terms.

Firſt I take the half of the *numerator* 192 and it is 96 then half of the *denominator* and it is 168, ſo that now it is brought to $\frac{96}{168}$ and next to $\frac{48}{84}$, and by halving ſtill to $\frac{24}{42}$ and their half is $\frac{12}{21}$ and now I can no longer half, it becauſe 21 is an odd *number*, wherefore I try to divide them by 3, 4, 5, 6, &c. and I find 3 divides them both without any remainder, and brings them to $\frac{4}{7}$ as *per margent*.

192	96	48	24	12	4
336	168	84	42	21	7

So I conclude $\frac{4}{7}$ thus found to be equal in vallue to the given *fractions* $\frac{192}{336}$.

2. What is $\frac{1036}{84}$ in its loweſt terms? *anſwer* $\frac{7}{8}$.

3. What is $\frac{13428}{526}$ in its loweſt terms? *anſwer* $\frac{11}{13}$.

There is yet another way more excellent then the former to reduce a *fraction* into its loweſt terms, and that is by finding a common meaſurer, *viz.* the greateſt *number* that will divide the *numerator* and *denominator* without any remainder, and by that means reduce a *fraction* to its loweſt terms at the firſt work, and to find out this common meaſurer, divide

Vide Ought. cla. Math. cap. 7.

vide the *denominator* by the *numerator*, and if any thing remains divide your diviſor thereby, and if any thing *remains* then divide your laſt diviſor by it, do ſo untill you find nothing *remains*, then this laſt diviſor ſhall be the greateſt common meaſurer, which will divide both *numerator* *denominator* and reduce them into their loweſt terms at one work.

Example.

4. Reduce $\frac{228}{304}$ into its loweſt terms by a common meaſurer. To effect which I divide the *denominator* 304 by the *numerator* 228 and there *remains* 76, then I divide 228, (the firſt diviſor) by 76 (the *remainder*) and it quotes 3 and *remains* nothing wherefore the laſt diviſor 76 is the common meaſurer, by which I divide the *numerator* of the given *fraction, viz.* 228 it quotes 3 for a new *numerator*, then I divide the *denominator* 304 by 76 and it quotes 4 for a new *denominator*, ſo that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its loweſt terms by a common meaſurer, *facit* $\frac{9}{11}$.

6. Reduce $\frac{30812}{38412}$ into its loweſt terms by a common meaſurer *facit* $\frac{13}{16}$.

A Compendium.

Note that if the *numerator and denominator* of a *fraction* end each with a Cypher

or Cyphers then cut of as many cyphers from the one as from the other and the *remaining* figures will be a *fraction* of the ſame vallue, *viz.* $\frac{34}{71}\frac{000}{000}$ will be found to be reduced to $\frac{34}{71}$ by cutting of the 2 cyphers from the *numerator and denominator* thus, $\frac{34}{71}\left|\frac{000}{000}\right.$ and $\frac{460}{700}$ will be $\frac{46}{70}$ th[illegible] $\frac{46}{70}\frac{10}{00}$ &c.

V. *To find the vallue of a fraction in the known parts of Coyn, weight,* &c.

The rule is.

Multiply the *numerator* by the parts of the next inferiour *denomination* that are equal to an unit of the ſame *denomination* with the *fraction*, then divide that product by the *denominator*, and the quote gives you its value, in the ſame parts you multiplyed by, and if any thing *remain* multiply it by the parts of the next inferiour *denomination*, and divide as before, do ſo till you can bring it no lower and the ſeveral quotients will give you the vallue of the *fraction* as was required, and if any thing at laſt *remain* place it for a *numerator* over the former *denominator*, example.

1. What

1. What is the value of $\frac{27}{29}$ l. *Sterling?* To Anſwer this queſtion I multiply the numerator 27 by 20 (the ſhillings in a pound) the product is 540 which I divide by 29 (the denominator) and the quotient is 18 *s.* and there Remains 18 which I multiply by 12 pence and the product (216) I divide by the denominator 29 the quotient is 7 *d.* and 13 Remains, which I multiply by 4 farthings, the product is 52, which I ſtill divide by 29, the quotient is 1 farthing, and there Remaineth 23, which I put for a Numerator over the denominator 29, ſo I find the vallue of $\frac{27}{29}$ *l.* to be 18 *s.* 7 *d.* 1 *qrs.* $\frac{23}{29}$ as *per* the following operation.

$\frac{27}{29}$ l.

27

Multiply 20

29) 540 (18 s.

29

250

232

Remains (18)

Multiply 12

36

18

29) 216 (7 d.

203

Remains (13)

Multiply 4

qrs.

29) 52 ($1\frac{23}{29}$

29

Remains (23)

s. d. qrs.

Facit 18---7---$1\frac{23}{29}$

2. What is the value of $\frac{11}{15}$ *l. Sterling*? *facit* 14 *s.* 8 *d.*

3. What

3. What is the value of $\frac{28}{137}$ *l. Sterling*? *facit* 4 *s.* 1 *d.* $\frac{7}{137}$.

4. What is $\frac{16}{21}$ *C.* weight? *facit* 3 *qrs.* 1 *l.* 5 *oz.* $\frac{7}{21}$.

5. What is $\frac{136}{371}$ *l. Troy* weight? *facit* 4 *oz.* 7 *p.w.* 23 *gr.* $\frac{179}{371}$.

6. What is $\frac{41}{50}$ of a year? *Anſwer* 299 *day.* 7 *hour.* 12 *min.*

VI. To Reduce a Compound Fraction *to a ſimple one of the ſame value.*

What a compound Fraction is, hath been ſhewed in Chap. 1. Definition 24, and to Reduce it to a ſimple Fraction of the ſame value.

The Rule is,

Multiply the Numerators continually and place the laſt product for a new Numerator, then multiply the denominators continually, and place the laſt product for a new denominator. So this ſingle Fraction ſhall be equal to the compound fraction given. Example.

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a Simple Fraction.

Multiply the Numerators 2, 3, and 5 toge-

together, they make 30, for a new Numerator; then I multiply the denominators 3, 5, and 8 together and their product is 120 for a denominator, ſo the ſimple Fraction is $\frac{30}{120}$ and cutting off the Cyphers it is $\frac{3}{12}$ equal to $\frac{1}{4}$.

5	3
3	2
15	6
8	5
120	30

Facit $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{4}$

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$ *Anſwer* $\frac{1540}{7560}$ or $\frac{154}{756}$ or $\frac{77}{378}$.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$ *Anſwer* $\frac{3003}{4872}$.

By this you may know how to find the value of a Compound Fraction, *viz.* firſt Reduce it to a ſimple one, and then find out his value by the 5 Rule foregoing.

4. What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a pound *Anſwer* 11 *s.* 3 *d.*

VII. *To*

VII. *To Reduce Fractions of unequal denominators to Fractions of the same value, having equal Denominators.*

The Rule is,

Multiply all the denominators together, and the product ſhall be the Common denominator? Then multiply each Numerator into all the denominators except its own, and the laſt product put for a Numerator over the denominator found out as before; So this new Fraction is equal to that fraction whoſe Numerator you multiplyed into the Denominators. Do ſo by all the Numerators given, and you have your deſire. Example,

1. Reduce $\frac{3}{4}$ $\frac{4}{5}$ $\frac{5}{6}$ and $\frac{7}{8}$ into a common Denomination.

Multiply the Denominators 4, 5, 6, and 8 together continually, and the product is 960 for the common Denominator; then multiply the Numerator 3 into the Denominators 5, 6, and 8, and the product is 720, which is a Numerator to 960 (found as before) ſo $\frac{720}{960}$ is equal to the firſt fraction

ction $\frac{3}{4}$, then I proceed to find a new Numerator to the ſecond fraction, *viz.* 4, and I multiply 4 (into all the denominators except its own; *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the Numerator 5, into the denominators 4, 5, and 8, the product is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the Numerator 7 into the denominators 4, 5, and 6, the product is $\frac{840}{960}$ equal to $\frac{7}{8}$ and the work is done, ſo that for $\frac{3}{4}$ $\frac{4}{5}$ $\frac{5}{6}$ and $\frac{7}{8}$ I have $\frac{720}{960}$, $\frac{768}{960}$ $\frac{800}{960}$ and $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$ $\frac{14}{23}$ and $\frac{19}{21}$ into a common denominator, *faciunt* $\frac{5313}{5796}$ $\frac{3528}{5796}$ and $\frac{5244}{5796}$.

VIII. To Reduce a fraction of one Denomination to another.

1. This is either Aſcending, or Deſcending. Aſcending when a fraction of a ſmaller is brought to a greater Denomination; and Deſcending when a fraction of a greater Denomination is brought lower.

2. When a fraction is to be brought from a leſſer to a greater Denomination, then make of it a Compound fraction, by comparing it with the intermediate Denominations between it, and that you would have

have it Reduced to, then (by the 6 Rule foregoing) Reduce your compound to a ſimple fraction, and the work is done. Example.

Queſt. 1. It is Required to know what part of a pound *ſterling* $\frac{5}{7}$ of a peny is?

To Reſolve this, I conſider that 1 *d.* is $\frac{1}{12}$ of a ſhilling, and a ſhilling is $\frac{1}{20}$ of a pound; wherefore $\frac{5}{7}$ *d.* is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a pound, which by the ſaid 6th. *Rule* I find to be $\frac{7}{1680}$ *l.*

Queſt. 2. What part of a pound *Troy* weight is $\frac{4}{5}$ of a peny weight? *Anſwer* $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy.*

3. VVhen a fraction is to be brought from a greater to a leſſer denomination, then multiply the Numerator by the parts contained in the ſeveral denominations betwixt it, and that you would reduce it to, then place the laſt product over the denominator of the given fraction. Example,

Queſt. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a peny? to do which I multiply the Numerator 3 by 20 and 12 the product is 720 which I put over the denominator 5 it makes $\frac{720}{5}$ of a peny, equal to $\frac{3}{5}$ *l.*

Queſt. 4. VVhat parts of an ounce *Troy* is $\frac{5}{6}$ *l.*? Anſwer $\frac{600}{6}$ *oz.*

CHAP.

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common Denominator, then add all the Numerators together, and place their ſum for a Numerator to the common Denominator, which new Fraction is the ſum of all the given Fractions; and if it be Improper, Reduce it to a whole, or mixt Number, by the 3 Rule of the 19 Chap.

Queſt. 1. What is the ſum of $\frac{7}{24}$ $\frac{9}{24}$ $\frac{16}{24}$ and $\frac{14}{24}$?

The Denominators are equal, *viz.* 24, wherefore add the Numerators together, *viz.* 7, 9, 16, and 14, their ſum is 46, which put over the Denominator 24, it makes $\frac{46}{24}$ the ſum of the given Fractions, which will be Reduced to the mixt Number $1\frac{22}{24}$ or $1\frac{11}{12}$.

2. But

2. But if the Fractions to be added have unequal Denominators, then Reduce them to a common Denominator, by the 7th. Rule of the 19th. Chap. and then add the Numerators together, and put the sum over the common Denominator, *&c.* as before.

Queſt. 2. What is the sum of $\frac{3}{5}$ $\frac{7}{8}$ $\frac{9}{11}$ and $\frac{11}{12}$?

The fractions Reduced to a common Denominator are $\frac{2880}{4800}$ $\frac{4200}{4800}$ $\frac{4320}{4800}$ and $\frac{4400}{4800}$, the sum of their Numerators is 15800 which put over the common Denominator makes $\frac{15800}{4800}$ or $\frac{158}{48}$ equal to the mixt Number $3\frac{14}{48}$ or $3\frac{7}{24}$ for the sum Required.

Queſt. 3. What is the sum of $\frac{13}{17}$ $\frac{21}{43}$ and $\frac{36}{47}$? *Anſwer* $1\frac{37555}{34051}$.

3. If you are to add mixt Numbers together, then add the fractional parts as before, and if their sum be an Improper Fraction Reduce it to a mixt Number, and add its Integral part to the Integral parts of the given mixt Numbers, and the work is done.

Queſt.

Queſt. 4. What is the ſum of 13 $\frac{3}{4}$ and 24 $\frac{5}{8}$?

Firſt add the fractions $\frac{3}{4}$ and $\frac{5}{8}$, ſum is $1\frac{1}{3}\frac{2}{2}$ then add this Integer 1, to 13 and 24 their ſum is 38, and put after it the fraction $\frac{1}{3}\frac{2}{2}$ it is $38\frac{1}{3}\frac{2}{2}$ for the *Anſwer*.

Queſt. 5. What is the ſum of $48\frac{3}{7}$ $64\frac{5}{8}$ and $130\frac{2}{4}$? *Facit* $243\frac{1}{2}\frac{8}{2}\frac{0}{4}$.

4. If any of the fractions to be added is a compound fraction, it muſt firſt be Reduced to a Simple Fraction by the 6th. Rule of Chapter 19, and then add it to the Reſt according to the 2d Rule of this Chapter. Example,

Queſt. 6. What is the ſum of $\frac{3}{5}$ $\frac{4}{6}$ and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$?

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a ſimple Fraction, and it is $\frac{1}{1}\frac{0}{9}\frac{5}{2}$ which Reduced with the other two, and added are $1\frac{2}{5}\frac{7}{7}\frac{6}{0}\frac{6}{0}$.

Queſt. 7. What is the ſum of $\frac{1}{1}\frac{1}{2}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? *Anſwer* $1\frac{4}{12}$.

5. If the Fractions to be added are not of one denomination, they muſt be ſo Reduced, and then proceed as before.

Queſt. 8. What is the ſum of $\frac{3}{4}$ *l.* and $\frac{5}{8}$ *s.*?

Here of the given Fractions, one is of a pound, and the other the fraction of a ſhilling; and before you can add them together, you muſt Reduce $\frac{5}{8}$ *s.* to the fraction of a pound

pound as the other is by the 8 Rule of Chapter 19, and it makes $\frac{5}{120}$ *l.* then $\frac{3}{4}$ *l.* and $\frac{5}{120}$ *l.* will be found to be $\frac{840}{960}$ *l.* or $\frac{8}{8}$ *l.* by the 7th. Rule of Chapter 19, and in its loweſt terms $\frac{19}{4}$ *l.* by the 4 Rule of Chapter 19.

It would have been the ſame, if (by the latter part of the 8th. Rule of Chapter 19) you had Reduced $\frac{3}{4}$ *l.* to the fraction of a ſhilling, which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the ſaid 7th. Rule of the laſt Chapter the ſum is 15 *s.* $\frac{30}{24}$ which is equal to the ſum found as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5th. Rule of Chapter 19) the vallue of $\frac{19}{24}$ *l.* will be found to be 15 *s.* 10 *d.* and ſo will 15 *s.* $\frac{20}{24}$ be found to be juſt as much.

Queſt. 9. What is the ſum of $\frac{3}{5}$ l. $\frac{3}{5}$ s. and $\frac{3}{5}$ d.? *Anſwer* $\frac{37950000}{60000000}$ or $\frac{37950}{60000}$ *l.*

Chap.

CHAP. XXI.

Subtraction of vulgar fractions.

1. THe rules in Addition for reducing the given fractions to one *denomination* are here to be obſerved; for before *Subtraction* can be made, the *fractions* muſt be reduced to a common *denominator*, then *Subtract* one *numerator* from the other, and place the *remainder* over the common *denominator*, which *fraction* ſhall be the exceſs or difference between the given *fractions*, example.

Queſt. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{7}$? the given *fractions* are reduced to $\frac{21}{28}$ and $\frac{20}{28}$, then *Subtract* the *numerator* 20 from the *numerator* 21, and there *remains* 1 which put over the *denominator* 28 makes $\frac{1}{28}$ for the anſwer, or difference between $\frac{3}{4}$ and $\frac{5}{7}$.

Queſt. 2. What is the difference between $\frac{5}{8}$ and $\frac{3}{5}$ of $\frac{5}{8}$?

reduce

Reduce the compound *fraction* $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple *fraction*, then proceed as be-before the anſwer is $\frac{110}{40}$ equal to $\frac{11}{24}$.

2. When a *fraction* is given to be *Sub-tracted* from a whole *number ſubtract* the *numerator* from the *denominator* and put the remainder for a *numerator* to the given *denominator*, and *Subtract* a unit (for that you borrowed) from the whole number, and the remainder place before the *fraction* found as before which mixt number is the remainder or difference ſought, example.

Queſt. 3. *Subtract* $\frac{7}{10}$ from 48 ?

Anſwer, $47\frac{3}{10}$ for if you *Subtract* 7 (the *numerator*) from 10 (the *denominator*) *re-mains* 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 reſts 47, to which joyn $\frac{3}{10}$ makes $47\frac{3}{10}$ for the exceſſe.

Queſt. 4. *Subtract* $\frac{13}{21}$ from 57 ? *re-mains* $56\frac{8}{21}$.

3. If it is required to *Subtract* a *fraction* from a mixt number, or one mixt Number from another reduce the the *fractions* to a common *denominator*, and if the *fraction* to be *Subtracted* be leſſer then the other, then *Subtract* the leſſer nu-merator from the greater, and that is a nu-merator for the common denominator; then *Subtract* the leſſer integral part from the greater, and the *remainder* with the

Queſt.

remaining *fraction* annexed is the difference required between the two given mixt numbers, example.

Queſt. 5. Subtract $26\frac{3}{7}$ from $54\frac{5}{6}$?

Firſt, Subtract $\frac{3}{7}$ *viz.* $\frac{11}{42}$ from $\frac{5}{6}$ *viz.* $\frac{35}{42}$ the remainder is $\frac{17}{42}$ then 26 from 54 remaineth 28 to which annex $\frac{17}{42}$ it makes $28\frac{17}{42}$ for the *Anſwer*.

4. But if the fraction to be Subtracted is greater then the fraction from whence you ſubtract, then take the numerator of the greater fraction out of the denominator, and add the remainder to the numerator of the leſſer fraction, and their ſum is a new numerator to the common denominator, which fraction note, then (for the unit you borrowed) add 1 to the integral part to be ſubtracted, and ſubtract it from the greater number, and annex the remainder to the fraction you noted before, ſo this new mixt number ſhall be the difference ſought, *Example*.

Queſt. 6. Subtract $14\frac{3}{4}$ from $29\frac{4}{7}$?

The fractions reduced are *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$ and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I ſhould ſubtract $\frac{21}{28}$ from $\frac{16}{28}$ but I cannot therefore I ſubtract 21 from 28 reſts 7 which added to 16 (the leſſer numerator) makes 23 for a numerator to 28 *viz.* $\frac{23}{28}$ then I come to the Integral parts 14 and 29 and ſay 1 that I bor-

borrowed and 15 from 29 reſts 14 to which annexing $\frac{2}{2}\frac{3}{8}$ it is $14\frac{2}{2}\frac{3}{8}$ for the remainder or difference between $14\frac{3}{4}$ and $29\frac{4}{7}$.

Queſt. 7. Subtract $36\frac{9}{10}$ from $74\frac{4}{9}$ *facit* $37\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. IF the multiplicand and multipliar are ſimple (or ſingle) fractions, then multiply the numerators together for a new numerator, and the denominators for a new denominator, which new fraction is the product required.

Queſt. 1. What is the product of $\frac{5}{7}$ by $\frac{9}{11}$? *facit* $\frac{45}{77}$.

For the numerator 5 and 9 multiplyed is 45 and the denominators 7 and 11 multiplyed is 77.

Queſt. 2. What is the product of

by $\frac{21}{37}$ *facit* $\frac{378}{851}$.

2. If the fractions to be multiplyed are mixt numbers, reduce them to improper fractions by the 1 Rule of the 19 Chap. then proceed as before.

Queſt. 3. What is the product of $48\frac{3}{5}$ by $13\frac{5}{6}$?

The given mixt numbers reduced to mixt numbers are $48\frac{3}{5}$ equal to $\frac{243}{5}$ and $13\frac{5}{6}$ equal to $\frac{83}{6}$ now $\frac{243}{5}$ multiplyed by $\frac{83}{6}$ according to the firſt Rule of this Chapter produceth $\frac{21069}{30}$ or $702\frac{9}{30}$.

Queſt. 4. What is the product of $430\frac{6}{15}$ by $18\frac{3}{7}$? *facit* $\frac{55547}{70}$ or $7935\frac{24}{70}$.

3. If a compound fraction is to be multiplyed by a ſimple fraction, firſt reduce the compound fraction into a ſimple fraction, then multiply the one by the other as is taught above.

Queſt. 5. What is the product of $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$? the compound fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduced is $\frac{60}{140}$ or $\frac{6}{14}$ which multiplyed by $\frac{16}{21}$ produceth $\frac{96}{294}$ which in its loweſt terme is $\frac{16}{49}$ for the anſwer.

And if the multiplicand and multipliar are both compound fractions, reduce them both to ſimple ones, then multiply theſe new fractions as before ſo have you the product.

Queſt. 6. What is the product of $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{3}{5}$ of $\frac{1}{2}$?

Anſwer.

Answ. $\frac{18}{120}$ in its lowest terms $\frac{3}{20}$.

Quest. 7. What is the product of $\frac{2}{5}$ of $\frac{3}{4}$ by $\frac{3}{5}$ of $\frac{1}{8}$?

Answ. $\frac{60}{360}$ or $\frac{1}{6}$ or in it least terms $\frac{1}{6}$.

4. If a fraction be to be multiplied by a whole number, put under the given whole a unit for a denominator, whereby it will be an improper fraction, then multiply these fractions as before, example.

Quest. 8. What is the product of 24 by $\frac{2}{3}$? Answ. $\frac{48}{3}$ for 24 by putting a unit under it will be $\frac{24}{1}$ & $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Quest. 9. What is the product of 36 by $\frac{18}{11}$? *Answer* $3\frac{14}{11}$ or 29 11.

CHAP. XXIII.

Division of Vulgar Fractions.

1. IF the dividend and the divisor are both simple fractions, then multiply the numerator of the dividend into the denominator of the divisor and the product is a

new numerator, then multiply the denominator of the dividend into the numerator of the divisor and the product is a new denominator, which new fraction thus found is the quotient you desire, example. Q. 1. What is the quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$? A. $\frac{25}{24}$ or $1\frac{1}{24}$ for first I multiply (5) the numerator of the dividend into (5) the denominator of the divisor and the product (25) is a numerator for the quotient, then I multiply (8) the denominator of the dividend into (3) the numerator of the divisor and the product (24) I put in the quotient for a denominator, so I find $\frac{25}{24}$ is the quotient sought. Q. What is the quotient of $\frac{16}{21}$ divided by $\frac{2}{3}$? A. $\frac{30}{42}$ equal to $\frac{5}{7}$ in its lowest terms.

$\frac{3}{5}) \frac{5}{8} (\frac{25}{24}$

2. But if you would divide a simple fraction by a compound, or a compound by a simple, first reduce such compound to a simple fraction, then go on as before. Q. 3. What is the quotient of $\frac{3}{1}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$? A. $\frac{36}{30}$ or $\frac{3}{5}$, first reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a simple fraction and it is $\frac{6}{12}$, by which $\frac{36}{30}$ being divided the quotient is $\frac{36}{30}$ equal in its least terms to $\frac{3}{5}$. And if the dividend, and divisor be both compound fractions, reduce them both to simple fractions, then divide the one by the other as in Rule 1 beforegoing.

Quest.

Queſt. 4, What is the quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{2}{5}$ of $\frac{5}{6}$?

Anſw. $\frac{180}{120}$ or $\frac{18}{12}$ or $1\frac{6}{12}$ or $1\frac{1}{2}$.

3. If the dividend, or diviſor, or both are mixt numbers reduce them to improper fractions, and perform diviſion as you were taught before, example.

Queſt. 5. VVhat is the quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Anſw. $\frac{225}{430}$ for $12\frac{3}{4}$ is equal to $\frac{51}{4}$ and $21\frac{4}{5}$ is equal to $\frac{109}{5}$ and the quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before $\frac{225}{430}$.

4. If you divide a fraction by a whole number, or a whole number by a fraction, make the whole number an improper *fraction* by putting an unit for a denominator to it as was taught in Rule 4 of Chap. 22. and then perform diviſion as before was taught, example.

Queſt. 6. VVhat is the quote of 8 divided by $\frac{3}{5}$?

Anſw. $\frac{40}{3}$ or elſe $13\frac{1}{3}$ which is equal thereto, the work is in the margent.

$\frac{3}{5}) \frac{8}{1} (\frac{40}{3}$ or $13\frac{1}{3}$

Queſt. 7. VVhat is the quote of $\frac{3}{5}$ diby 8?

Anſwer. $\frac{3}{40}$ as per margent.

$\frac{8}{1}) \frac{3}{5} (\frac{3}{40}$

CHAP. 24.

CHAP. XXIV.

The Rule of three direct in vulgar fractions.

1. AS in the *rule* of 3 in whole *numbers* so likewise in *fractions*, you must see that the *fractions* of the first and third places be of the same denomination.

2. See that if any of the given *fractions* be compound, that they be reduced to simple of the same vallue.

3. If there are given mixt numbers, reduce them to improper *fractions* by the 1 Rule of Chap. 19.

4. If any of the 3 terms is a whole *number* make it an improper *fraction* by constituting unit for its *denominator*.

Having reduced your *fractions* as is directed in the 4 last *rules*, then proceed to a resolution, which is performed the same way as in whole *numbers*, respect being had to the *rules* delivered for the working of *fractions*, *viz.* multiply the second and 3

fractions

fractions together according to the 1 Rule of Chap. 22 and divide the product by the first *fraction*, according to the 1 Rule of Chap. 23. and the quotient is the answer.

Or, (which is better)

5. Multiply the *numerator* of the first *fraction* into the denominators of the second and third, and the product is a new *denominator*, then multiply the denominator of the first *fraction* into the numerators of the second and third, and the product is a new numerator; which new *fraction* is the 4th. *proportional*, or *answer*, which (if it is an improper *fraction*) must be reduced to a whole or mixt number by the 3 Rule of Chap. 19. examples.

Queſt. 1. If $\frac{3}{4}$ yds. of Cloath coſt $\frac{5}{8}$ l. what will $\frac{9}{10}$ yds. coſt?

Having placed the given *fractions* according to the 6 Rule of Chap. 10. I proceed to reſolution, and firſt I multiply the numerator of the firſt *fraction* (3) into 8 and 10 the denominators of the ſecond and third *fractions* and the product is 240 for a denominator, then I multiply 4 the denominator of the firſt *fraction*

yds.	*l.*	*yds.*	*l.*
3	5	9	180
4	8	10	240

facit $\frac{180}{240}$ *l.* equal to $\frac{3}{4}$ *l.*

into 5 and the numerators of the second and third *fractions*, the product is 180 for a numerator, which numerator 180 and denominator 240 make $\frac{180}{240}$ l. for the Answer. equal to $\frac{3}{4}$ l. or 15 s.

Queſt. 2. If $\frac{2}{3}$ l. buy $\frac{5}{8}$ yds. of Cloath, what will $\frac{11}{12}$ yds. coſt at that rate?

Anſwer. $\frac{132}{80}$ l. equal to $\frac{11}{15}$ l. or 14 s. 8 d.

Queſt. 3. If $\frac{7}{8}$ l. coſt $\frac{2}{6}$ s. what will $\frac{8}{9}$ s. buy?

Anſwer. $\frac{336}{448}$ l. equal to $2\frac{1}{3}$ l.

Queſt. 4. If $\frac{3}{5}$ of an ell of *Holland* coſt $\frac{1}{8}$ of a pound how much will $12\frac{2}{3}$ ells coſt at that rate?

Anſw. $\frac{190}{72}$ equal to $2\frac{23}{36}$ l.

In reſolving the laſt queſtion and the two next obſerve the 3 Rule of this Chap. foregoing.

Queſt. 5. If $\frac{9}{10}$ of a C. coſt $28\frac{3}{4}$ s. what will $7\frac{1}{2}$ C. coſt at that rate?

Anſw. $239\frac{7}{12}$ s. or 11 *l.* 19 *s.* 7 *d.*

Queſt. 6. $3\frac{1}{4}$ yds of Velvet coſt $3\frac{5}{8}$ l. how much will $10\frac{1}{2}$ yds coſt at that rate.

Anſw. $11\frac{37}{52}$ l.

Queſt. 7. If 3 yds of broad Cloth coſt $2\frac{4}{5}$ l. what will $14\frac{3}{7}$ yds coſt?

Anſw. 13 *l.* 9 *s.* 4 *d.*

In working the laſt queſtion and the 4 next obſerve the 4 Rule of this Chap. foregoing.

Queſt.

Queſt. 8. If 14 l. of Pepper coſt 14 s. $6\frac{3}{5}$ d. I demand the price of $72\frac{3}{4}$ l.

Anſwer. 3 *l.* 15 *s.* $7\frac{83}{160}$ *d.*

Queſt. 9. If 1 l. of Couchenele coſt 1 l. 5 s. what will $36\frac{7}{10}$ l. coſt?

Anſwer. 45 *l.* 17 *s.* 6 *d.*

Queſt. 10. If 1 yd. of broad-cloth coſt $15\frac{5}{8}$ s. what will 4 peices each contain $27\frac{3}{7}$ yds. at that rate?

Anſwer. 85 *l.* 14 *s.* $3\frac{3}{7}$ *d.*

Queſt. 11. A Mercer bought $3\frac{1}{2}$ pcs of ſilk each peice qt. $24\frac{2}{3}$ ells at 6 s. $0\frac{3}{4}$ d. per ell I demand the value of the $3\frac{1}{2}$ pcs at that rate?

Anſwer. 26 *l.* 3 *s.* $4\frac{3}{4}$ *d.*

In ſolving the 4 next queſtions obſerve the 8 Rule of Chap. 19.

Queſt. 12. If $\frac{2}{5}$ of an ounce of Silver coſt 2 s. I demand the price of $11\frac{2}{3}$ l. at that rate? Anſwer 35 l.

Queſt. 13. If $1\frac{5}{7}$ l. of gold is worth $61\frac{5}{7}$ l. *ſterling*, what is 1 grain worth at that rate? Anſwer $1\frac{1}{2}$ d.

Queſt. 14. If $\frac{3}{4}$ yds. of ſilk is worth $\frac{3}{4}$ of $\frac{5}{6}$ l. wt. is the price of $15\frac{2}{5}$ ells Flemiſh?

Anſwer. 9 *l.* 12 *s.* 6 *d.*

Queſt. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves coſt 6 s. $2\frac{1}{7}$ d. what coſt the C. weight at that Rate? Anſwer. 69 *l.* 4 *s.*

CHAP. XXV.

The Rule of Three Inverse in fractions.

1. IT hath bin already taught (in the 3 rule of the 11 Ch.) how to discover when the 4th proportional number (to the 3 given numbers) is to be found out by a Rule of 3 direct, and when by a Rule of 3 inverse to which Rule the learner is now referred.

2. When (In fractions) you find a question to be solved by the Rule of 3 Inverse, *viz.* when the third term is the divisor, then (having reduced the terms exactly according to the Rules in Chap 24.) multiply the numerator of the 3 fractions into the denominators of the second and first fractions, and the product is a new denominator, then multiply the denominator of the third fraction into the numerators of the second and first fractions, and the product is a new numerator, which new fraction thus found

is

is the Anſwer to the queſtion.

Queſt. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 yds wide will make a garment, how much of any other Drapery that is $\frac{3}{5}$ of a yard wide will make the ſame garment?

Anſwer. $2\frac{1}{2}$ yds.

Queſt. 2. Lent my friend 46l. for $\frac{4}{5}$ of a year how much ought he to lend me for $\frac{7}{12}$ of a year.

Anſwer. $63\frac{5}{8}$.

Queſt. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ yards wide will make any garment what breadth is that Cloath when $1\frac{3}{4}$ yds will make the ſame garment?

Anſwer. $\frac{56}{3}$ of a yd wide.

Queſt. 4. How many inches in length of a board that is 9 Inches broad, will make a foot ſquare?

Anſwer. 16.

Queſt. 5. If when the buſhel of wheat coſt $4\frac{3}{4}$ s. the peny loaf weigheth $10\frac{2}{3}$ ounces what will it weigh when the buſhel coſt $8\frac{9}{10}$ s.?

Anſwer. $5\frac{1}{2}\frac{8}{6}\frac{5}{7}$ ounces.

Queſt. 6. If 12 men can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ days in how many days will 6 men do the ſame?

Anſwer. in $21\frac{1}{3}$ dayes.

CHAP. XXV.

The Rule of Three Inverse in fractions.

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2. When (In fractions) you find a question to be solved by the Rule of 3 Inverse, *viz.* when the third term is the divisor, then (having reduced the terms exactly according to the Rules in Chap 24.) multiply the numerator of the 3 fractions into the denominators of the second and first fractions, and the product is a new denominator, then multiply the denominator of the third fraction into the numerators of the second and first fractions, and the product is a new numerator, which new fraction thus found

is

is the Answer to the question.

Quest. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 yds wide will make a garment, how much of any other Drapery that is $\frac{3}{5}$ of a yard wide will make the same garment?

Answer. $2\frac{1}{2}$ yds.

Quest. 2. Lent my friend 46l. for $\frac{4}{5}$ of a year how much ought he to lend me for $\frac{7}{12}$ of a year.

Answer. $63\frac{5}{7}$.

Quest. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ yards wide will make any garment what breadth is that Cloath when $1\frac{3}{4}$ yds will make the same garment?

Answer. $\frac{56}{3}$ of a yd wide.

Quest. 4. How many inches in length of a board that is 9 Inches broad, will make a foot square?

Answer. 16.

Quest. 5. If when the bushel of wheat cost $4\frac{3}{4}$ s. the peny loaf weigheth $10\frac{2}{3}$ ounces what will it weigh when the bushel cost $8\frac{9}{10}$ s.?

Answer. $5\frac{1}{2}\frac{8}{6}\frac{5}{7}$ ounces.

Quest. 6. If 12 men can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ days in how many days will 6 men do the same?

Answer. in $21\frac{1}{3}$ dayes.

CHAP. XXVI.

Rules of Practice.

1. IN the ſingle Rule of 3 when the firſt of the 3 numbers in the queſtion (after they are diſpoſed according to the 6 Rule of the 10 ch.) happeneth to be a unit (or 1) that queſtion many times may be reſolved far more ſpeedily then by the Rule of 3, which kind of operation is commonly called Practice, and indeed it is of excellent uſe amongſt Merchants, Tradesmen and others, by reaſon of its ſpeedineſs in finding a reſolution to ſuch kind of queſtions.

2. The cheifeſt queſtion reſolveable by theſe brief Rules may be comprehended under the ſeven general heads or caſes following (*viz.*)

When

when the given price of the integer Consists.

1 *Of farthings under* 4
2 *Of pence under* 12
3 *Of pence and farthings*
4 *Of ſhillings under* 20
5 *Of ſhill. pence and farthings*
6 *Of Pounds*
7 *Of pounds, ſhillings, pence and farthings.*

It would be very convenient for the practical Arithmetician, to have by heart the ſeveral products of the 9 digits multiplyed by 12, for his ſpeedy reducing pence into ſhillings or ſhillings into pence, which he may gain by the following Table.

12 Times	1	is	12
	2		24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108

3. Shillings are practically reduced into pounds thus, *viz.* cut of the figure ſtanding in the place of units with a daſh of the pen

pen and note it for ſhillings, then draw a line under the given number and take half of the remaining figures (after the firſt is cut off) and ſet them under the line, and they are ſo many pounds, but if the laſt figure is odd,

436518	
l.	s.
2182	18

then take the leſſer half and add 10 to the figure ſo cut off (as before) for ſhillings, as if I were to reduce 43658 ſhillings into pounds, firſt I cut of the laſt figure (8) for ſhillings, then I take half of the remaining figures (4365) thus half of 4 is 2, which I put under the line, then $\frac{1}{2}$ of 3 is 1, and becauſe 3 is an odd number I make the next figure 6 to be 16, and go on ſaying $\frac{1}{2}$ of 16 is 8, and then $\frac{1}{2}$ of 5 is 2 which is the laſt figure, wherefore becauſe 5 is an odd number I add 10 to the 8 I cut off and it makes 18 s. ſo that I find it to be 2182 l. 18 s. as *per margent*.

4. It is likewiſe Convenient that the Learner be acquainted with the Practical Tables following, the firſt containing the Aliquot (or even) parts of a ſhilling, the ſecond containing the Aliquot parts of a pound.

	d.		*s.*
The even parts of a shilling.	6	is	$\frac{1}{2}$
	4		$\frac{1}{3}$
	3		$\frac{1}{4}$
	2		$\frac{1}{6}$
	$1\frac{1}{2}$		$\frac{1}{8}$
	1		$\frac{1}{12}$

	s. *d.*		*l.*
The even parts of a pound.	10—00	is	$\frac{1}{2}$
	6—08		$\frac{1}{3}$
	5—00		$\frac{1}{4}$
	4—00		$\frac{1}{5}$
	3—04		$\frac{1}{6}$
	2—06		$\frac{1}{8}$
	2—00		$\frac{1}{10}$
	1—08		$\frac{1}{12}$
	1—00		$\frac{1}{20}$

Case 1.

5. VVhen the price of the Integer is a farthing, then take the ſixth part of the given Number which will be ſo many three half pence, and if any thing Remains it is farthings by the 7th. Rule of Chapter 9, then conſider that three half-pence is $\frac{1}{8}$ of a ſhilling

ſhilling, wherefore take the eighth parts of them for ſhillings, and if any thing Remain, they are ſo many 3 half-pence, which Reduce into pounds by the 3d Rule foregoing. Example 67486 *l.* at a farthing *per l.* Firſt I take $\frac{1}{8}$ of 67486, and it is 11247 three half-pence and 4 farthings, or 1 peny, then $\frac{1}{8}$ of 11247 is 1405 *s.* and 7 Remains, which is 7 three half penies or 10 *d.* $\frac{1}{2}$ which with the 4 farthings before make 11 $\frac{1}{2}$ and 1405 ſhillings which by the 3 Rule is 70 *l.* 5 *s.* In all 70 *l.* 5 *s.* 11 *d.* $\frac{1}{2}$ for the *Anſwer*, See the work following.

		d.
$\frac{1}{8}$	67486	at $\frac{1}{4}$ per *l.*
		d.
$\frac{1}{8}$	11247	--- 1
$2\frac{1}{8}$	1405	--- 10 $\frac{1}{2}$
	l. *s.*	*d.*
	70 --- 5	--- 11 $\frac{1}{2}$ *fac.*

Other

Other Examples follow.

$\frac{1}{6}$	8576 *l. at* 1 *qrs.*	$\frac{1}{6}$	6380 *l. at* 1 *qrs.*
$\frac{1}{8}$	1429 2 *qrs.*	$\frac{1}{8}$	1063 2 *qrs.*
$2\frac{1}{20}$	1718—8 *d.*	$\frac{1}{20}$	1312—11 *d.*
	l. s. d.		l. s. d.
	8---18---8 *facit*		6--12--11 *facit*

6. When the price of the Integer is 2 farthings, then take the third part of the given Number for ſo many three half-pence, and the Remainder (if any) is half-pence, then take the eighth part of that for ſhillings as before, *&c.*

Examples.

$\frac{1}{3}$	7368 *l. at* 2 *qrs.*	$\frac{1}{3}$	8347 *l. at* 2 *qrs.*
$\frac{1}{8}$	2456	$\frac{1}{8}$	2782 2 *qrs.*
$\frac{1}{20}$	3017	$\frac{1}{10}$	3417----9 *d.* $\frac{1}{2}$
	l. s.		l. s. d.
	15 —— 7 *facit*		17-7-9$\frac{1}{2}$ *facit*

7. When the price of the Integer is 3 farthings then take half the given Number for three half-penies (and if any thing Remain it is 3 farthings, then take the eighth of

of that for ſhillings as before, *&c.*

Examples.

$\frac{1}{2}$	4736 *l.* at 3 *qrs.*		$\frac{1}{2}$	5425 *l.* at 3 *qrs.*	
$\frac{1}{8}$	2368		$\frac{1}{8}$	2712	3 *qrs.*
$\frac{1}{20}$	2916		$\frac{1}{20}$	3319	
	l.	s.		l. s. d. qrs.	
	14	16 *facit*		16-19-0--3 *facit*	

Caſe 2.

8. VVhen the given price of the Integer, is a part, or parts of a ſhilling (*viz.* pence) divide the given Number of Integers (whoſe value is ſought) by the denominator, of the fraction Repreſenting the even part, and the quote is ſhillings, (allwayes minding the 7th. Rule of Chapter 9) and thoſe ſhillings may be Reduced to *l.* by the 3 Rule of this Chapter. Example, Let it be Required to find the value of 438 *l.* at 3 *d. per l.* I conſider 3 *d.* is $\frac{1}{4}$ of a ſhilling, and 438 *l.* will coſt ſo many 3 pences, wherefore I divide 438 by 4 the denominator of $\frac{1}{4}$ and the quote is 109 ſhillings, and 2 Remains, which is 2 three pences or 6 *d.* the whole value is 5 *l.* 9 *s.* 6 *d.*

6 *d.* as by the following work appeareth

1/4	438 *l. at* 3 *d.*
1/20	1019——6

l.	s.	d.
facit 5	—9	—6

More Examples follow.

1/2	3574 *at* 6 *per l.*	1/6	5316 *at* 2 *per l.*
1/20	17817	1/20	8816

facit 89 *l.* 7 *s.* 44 *l.* 6 *s. facit*

1/3	438 *at* 4 *per l.*	1/8	6389 *at* 1½ *per l.*
1/20	1416	1/20	7918——7 *d.* ½

facit 7 *l.* 6 *s.* *facit* 39 *l.* 18 *s.* 7 *d.* ½

1/4	879 *at* 3 *per l.*	1/12	818 *at* 1 *per l.*
1/20	2119——9 *d.*	1/20	618——2 *d.*

facit 10 *l.* 19 *s.* 9 *d* 3 *l.* 8 *s.* 2 *d. facit*

9. If

9. If the price of the Integer be pence under 12 and yet not an even part, then it may be divided into even parts, and ſo the parts of the given Number taken accordingly, and added together as if it were 5 *d.*; which is 3 *d.* and 2 *d. viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a ſhilling, firſt take $\frac{1}{4}$ of the given Number, and then $\frac{1}{6}$ thereof, and add them together, and their ſum is the Anſwer in ſhillings, ſtill obſerving Rule 7 of Chap. 9. for the Remainders (if any be) then bring the ſhillings into pounds by the 3 Rule foregoing. Likewiſe 7 *d.* is $\frac{1}{3}$ and $\frac{1}{4}$ ſo 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$ and 10 *d.* is $\frac{1}{2}$ and $\frac{1}{3}$ and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a ſhilling, as in the following Examples, *viz.*

l.	d.	
439	*at* 5	*per l:*
1/3 1/4	146—4	
	36—7	
	1812--11	
	9 l. 2 s. 11 d. facit	

ells	d.	
587	*at* 7	*per ell*
1/3 1/4	195—8	
	146—9	
	341[2---5	
	17 l. 2 s. 5 d. facit	

yds.	d.	
836	*at* 8	*per yd:*
1/3 1/3	278—8	
	278—8	
	5517—4	
	127 l. 17 s. 4 d. facit	

yds.	d.	
417	*at* 9	*per yd.*
1/2 1/4	208---6	
	104---3	
	3112-9	
	15 l. 12 s. 9 d. facit	

ells	d.	
386	*at* 10	
1/2 1/3	193	
	128—8	
	3211---8	
	16 l. 01 s. 8 d. facit	

l.	d.	
534	*at* 11	
1/3 1/3 1/4	178	
	178	
	133—6	
	4819—6	
	24 l. 9 s. 6 d. facit	

Case 3.

Case 3.

10. When the price of the integer is pence and farthings, if it make an even part of a shilling work as before, but if they are uneven as peny farthing, peny three farthings, 2 d. 1 qrs. or 2 d. 3 qrs. 3 d. 3 qrs. or the like, then first work for some even part, and then consider what part the rest is of that even part, and divide that quotient thereby, then add them together and reduce them to pounds as before, example 3470 l. at 1 d. 1 qrs. *per* l. first I work for the peny by dividing 3470 by 12 for 1 d. is $\frac{1}{12}$ of a shilling, and the quote is 289 s. 2 d. then I conceive that 1 farthing is $\frac{1}{4}$ of a peny, and the vallue at 1 farthing, will be $\frac{1}{4}$ of the vallue at 1 peny and therefore I take $\frac{1}{4}$ of 289 s. 2 d. which is 72 s. 3 d. 2 qrs. and add them together and they are 181. 1 s. 5 d. 2 qrs. as by the margent, other examples in the same nature follow.

l.	*qrs.*
3470	*at* 5
289	2
72	3 2
3611	5 2

l.	*s.*	*d.*	*qrs.*
18	1	5	2

	l.	d.
	4360 at	$1\frac{1}{4}$
$\frac{1}{2}$	363 —	4
$\frac{1}{4}$	90 —	10
	4514 —	2
	l. s.	d.
	22 14	2 *facit*

	yds.	d.
	573 at	$1\frac{3}{4}$
$\frac{1}{8}$	71	$7\frac{1}{2}$ *d.*
$\frac{1}{8}$	11	$11\frac{1}{4}$
	813	$6\frac{3}{4}$
		l. s. d.
	facit	4 3 $6\frac{3}{4}$

$\frac{1}{6}$	485 l. at	$2\frac{1}{4}$ d.
$\frac{1}{8}$	80	10 d.
	10	$1\frac{1}{4}$
	910	$11\frac{1}{4}$
	4 l. 10 s.	$11\frac{1}{4}$ d.

$\frac{1}{2}$	520 yds at	$7\frac{1}{2}$
$\frac{1}{4}$	66	
	265	
	3215	
	16 l. 5 s.	*facit*

$\frac{1}{6}$	654 l. at	$2\frac{1}{2}$ d.
$\frac{1}{4}$	109	
	27	3 d.
	1316	3
	6 l. 16 s.	3 d.

	137 yds at	$10\frac{1}{2}$ d.
$\frac{1}{2}$	68	6 d.
$\frac{1}{4}$	34	3
$\frac{1}{8}$	17	$1\frac{1}{2}$
	119	$10\frac{1}{2}$ d.
	5 l. 19 s.	$10\frac{1}{2}$ d. *facit*

Case 4.

Case 4.

11. When the price of the Integer is 2 s. then cut of the figure in the place of units of the given number, and double it for shillings, and the figures of the other hand are pounds, example 436 yds at 2 s. *per yd.* cut of the last figure 6 and double it, it makes 12 shill. and the other 2 figures, *viz.* 43 are so many pounds so that their vallue is 43 l. 12 s. as *per margent.*

4316

43 l. 12 s.

12. Hence it is evident that (when the given price of the integer is an even number of shillings then) if you take half of that (even) number of shillings, and multiply the given number of integers thereby, doubling the first figure of the product and setting it a part for shill. the rest of the product will be pounds, which pounds and shill. is the vallue sought, example, what cost 536 yds. at 8 s. *per* yd. ? to resolve which I take $\frac{1}{2}$ of 8 s. (the price of a yd.) which is 4 and multiply 536 thereby, saying 4 times 6 is 24 then I double the first figure 4 makes 8 for shill. and carry 2 to the next product &c. I find the rest of the product to be 214 which I note for

536 *yds. at* 8 *s.*

214 *l.* 8 *s.*

for pounds so the vallue of 536 yds. at 8 s. *per* yd. is 214 l. 8 s. as per margent, more examples follow.

56 *yds. at* 6 *s. per yd.*	420 *yds. at* 12 *s. per yd.*
16 *l.* 16 *s. facit.*	252 *l. facit.*
123 *yds at* 4 *s. per yrd.*	326 *yds. at* 14 *s. per yd.*
24 *l.* 12 *s. facit.*	228 *l.* 4 *s. facit.*
48 *ells at* 8 *s. per ell.*	48 *yds. at* 16 *s. per yd.*
19 *l.* 4 *s. facit.*	38 *l.* 8 *s. facit.*
84 *yds. at* 10 *s. per yd.*	52 *yds. at* 18 *s. per yd.*
42 *l. facit.*	46 *l.* 16 *s.*

13. If the given price of the integer is an odd number of shillings, then work first for the even number of shillings by the last Rule, and for the odd shilling take $\frac{1}{20}$ of the given number of integers according to the 3 Rule of this Chapter and add them together and you have your desire, examples follow.

yds.	*s.*
422 *at*	3 *per yard*

l.	*s.*
42	4
21	2
63	6 *facit*

ells	*s.*
431 *at*	13

l.	*s.*
258	12
21	11
280	03 *facit*

ells	*s.*
516 *at*	7 *per ell*

l.	*s.*
154	16
25	16
180	12 *facit*

ells	*s.*
324 *at*	17 *per ell*

l.	*s.*
259	4
16	4
275	8 *facit*

14. Except when the given price of the Integer is 5 *s.* for then it is ſooner anſwered by taking of the given Number whoſe value is ſought, as in the following Example.

	yds.	*s.*
½	436 *at*	5 *per yard*
	109 *l. facit*	

	ells	*s.*
¼	206 *at*	5 *per ell*
	51 *l.*	10 *s. facit*

Caſe

Case, 5.

15. VVhen the given price of an integer is shillings and pence, or shillings, pence, and farthings, then if the shillings and pence be an even part of a pound divide the given number of integers whose value you seek by the denominator of that *fraction* representing that even part, as for example, what is the price of 384 yds at 6 *s.* 8 *d. per yd.*? here I consider that 6 *s.* 8 *d.* is $\frac{1}{3}$ of a pound wherefore I divide 384 by 3 and the quote is the answer *viz.* 128 *l.* so that 384 yds. at 6 *s.* 8 *d. per yd.* amounts to 128 *l. per margent*, still observing the 7 Rule of the 9 Chap.

$\frac{1}{3}$	384
	128 *l.*

More Examples follow.

$\frac{1}{3}$	438 *ells at* 6 *s.* 8 *d.*	$\frac{1}{8}$	433 *yds. at* 2 *s.* 6 *d.*
	146 *l. facit*		54 *l.* 2 *s.* 6 *d. facit*
$\frac{1}{6}$	525 *at* 3 *s.* 4 *d.*	$\frac{1}{12}$	726 *yds at* 1 *s.* 8 *d.*
	87 *l.* 10 *s. facit.*		60 *l.* 10 *s. facit*

16. When the given value of the Integer is ſhillings and pence, and not an even part of a pound, yet many times it may be divided into parts (*viz.* 6 *s.* 6 *d.* is 4*s.* and 2 *s.* 6 *d.* for the 4 *s.* work according to the 12 Rules foregoing, and for the 2 *s.* 6 *d.* take the eighth part of the given Number and add them together their ſum is the value Required.)

So 8 *s.* 6 *d.* will be divided into 6 *s.* and 2 *s.* 6 *d.* and the price of the given Number may be found out as before, *&c.* Examples follow.

	yds.	*s.*	*d.*
	386 *at*	8	--8
½	128 *l.*	13	--4
1/10	38	--12	--0
	167 *l.*	5 *s.*	4 *d. facit*

	ells	*s.*	*d.*
s.	427 *at*	8	--6
6	128 *l.*	2	--0
⅛	53	--7	--6
	181 *l.*	9 *s.*	6 *d. facit*

	ells	*s.*	*d.*
s.	540 *at*	5	--4
2	54 *l.*	0 *s.*	
1/6	90	--0	
	144 *l.*	0 *s.*	*facit*

	yds.	*s.*	*d.*
s	386 *at*	14	--8
8	154 *l.*	8	--0
	128	--13	--4
	283 *l.*	1 *s.*	4 *d. fac*

17. When the given price of the Integer is ſhillings and pence, and you cannot Readily divide them according to the laſt Rule

Rule then multiply the given Number whoſe value you ſeek by the Number of ſhillings in the price of the Integer, and then for the pence, work by the 8th. Rule foregoing, then add the Numbers together, and their ſum is the value ſought in ſhillings; as for Example, what is the value of 392 *yds.* at 6 *s.* 9 *d. per yard?* Here 6 *s.* 9 *d.* cannot be made any even part, nor indeed can it be divided into even parts of a pound, wherefore I multiply the given Number of *yards* 392 by 6 for the 6 *s.* the product is 2352 ſhillings, then for the 9 *d.* I divide it into 6 *d.* and 3 *d.*, and work for them by the 8th. Rule foregoing, and at laſt add the ſhillings together they make 2646 *s.* and by the 3 Rule they are reduced to 132 *l.* 6 *s.* the value of 392 *yds.* at 6 *s.* 9 *d. per yard.* See the work following.

		yds. *s.* *d.*
		392 *at* 6---0
		2352
	½	196
	¼	98
		2646
		132 *l.* 6 *s. facit*

Other

Other Examples follow.

	l.	*s*	*d.*
s.	480	*at* 4	--- 10
4	1920		
$\frac{1}{2}$	240		
$\frac{1}{3}$	160		
	23210		
	116 *l. facit.*		

	ells	*s.*	*d.*
s.	732 *at*	12	--- 7
12	8784		
$\frac{1}{3}$	244		
$\frac{1}{4}$	183		
	92111		
	460 *l.* 11 *s. facit*		

18. When the given price of the Integer is ſhillings, pence, and farthings, then multiply the given number of Integers by the Number of ſhillings contained in the value of the Integer, and for the pence and farthings follow the 10th. Rule of this Chapter

Exam.

Examples.

	yds.	s.	d.
	438 *at*	8	$6\frac{3}{4}$
s. 8	3504		
$\frac{1}{2}$	219	*d.*	
$\frac{1}{8}$	27	---	$4\frac{1}{2}$
	3751	0---	$4\frac{1}{2}$

facit 187 *l.* 10 *s.* 4 *d.* $\frac{1}{2}$

	ells	s.	d.
	370 *at*	14	--- $2\frac{3}{4}$
	1480		
s.	370		
14	5180	*d.*	
$\frac{1}{6}$	61	---	--- 8
$\frac{1}{4}$	15	---	--- 5
$\frac{1}{2}$	7	---	--- $8\frac{1}{2}$
	5261	4---	--- $9\frac{1}{2}$

fac. 263 *l.* 4 *s.* 9 *d.* $\frac{1}{2}$

	ells	s.	d.
s.	136 *at*	9	--- $2\frac{1}{2}$
9	1224	---	0 *d.*
$\frac{1}{6}$	22	---	8
$\frac{1}{4}$	5	---	8
	1251	2---	4

facit 62 *l.* 12 *s.* 4 *d.*

	ells	s.	d.
s.	431 *at*	2	--- $4\frac{1}{2}$
2	862		
$\frac{1}{4}$	107	---	9 *d.*
$\frac{1}{8}$	53	---	--- $10\frac{1}{2}$
	1021	3---	--- $7\frac{1}{2}$

fac. 51 *l.* 3 *s.* 7 *d.* $\frac{1}{2}$

Case 6.

19. When the given value of the Integer is pounds, then multiply the Number of Integers whose value is sought by the price of the Integer and the product is the Answer in pounds.

Examples.

C. *l.* 42 *at* 2 *per C.* 84 *l. facit*	*C.* *l.* 13 *at* 8 *per C.* 104 *l. facit*
C. *l.* 30 *at* 3 *per C.* 90 *l. facit*	*C.* *l.* 48 *at* 12 *per C.* 576 *l. facit.*

Case 7.

20. If the price of the Integer is pounds and ſhillings, then for the pounds work as in the laſt Rule, and for the ſhillings as in the 12 and 13 Rules before going; then add the Numbers produced from them both, and the ſum is the value ſought.

Exam-

Examples.

C.	*l.*	*s.*
46 *at*	2	4
92	*s.*	
	9	4
101 *l.* 4 *s. facit*		

groſs	*l.*	*s.*
82 *at*	4	10
328		
	41	
369 *l. facit*		

groſs	*l.*	*s.*
58	3	7
174	*s.*	
	17	8
	2	18
194 *l.* 6 *s. facit*		

groſs	*l.*	*s.*
26 *at*	3	15
78		
	18	4
	1	6
97 *l.* 10 *s. facit*		

21. When the given price of an Integer conſiſts of pounds ſhillings and pence, with farthings, then work for the ſhillings pence and farthings firſt, according to the 18. Rule of this Chap and finde the total vallue of the given number, as if there were no pounds, then work with the pounds according to the 19 Rule of this Chapter, and add the numbers thus found, and their ſum is the total value Required.

Examples of this Rule follow.

c.	*l.*	*s.*	*d.*
213	*at* 1	-- 13	-- $4\frac{1}{2}$
639			
213			
2769	*d.*		
53	-----	3	
26	-----	$7\frac{1}{2}$	
28418	----	$10\frac{1}{2}$	
142			
213			
355 *l.*	8 *s.*	10 *d.* $\frac{1}{2}$	*facit*

gross	*l.*	*s.*	*d.*
416	*at* 2	-- 9	-- $3\frac{3}{4}$
3744			
104			
26			
38714			
193 *l.*	14 *s.*		
832			
1025 *l.*	14 *s.*		*facit*

c.	*l.*	*s.*	*d.*
37	*at* 3	-- 8	-- $10\frac{1}{2}$
296	*d.*		
18	-- 6		
9	-- 3		
4	--- $7\frac{1}{2}$		
3218	-- $4\frac{1}{2}$		
16 *l.*	8 *s.*		
111			
127 *l.*	8 *s.*	4 *d.* $\frac{1}{2}$	*facit*

gross	*l.*	*s.*	*d.*
48	*at* 3	-- 15	-- $11\frac{1}{2}$
240			
48			
720			
24			
16			
6			
7616			
38	-- 6		
144			
182 *l.*	6 *s.*		*facit*

22. When

22. When there is given the value of an Integer, and it is required to know the value of many such Integers together with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an integer, then first (by the former rules) find out the value of the given number of Integers, and then for $\frac{1}{4}$ of an Integer take $\frac{1}{4}$ of the given value of the Integer, or for $\frac{1}{2}$ take $\frac{1}{2}$ of the given value of the integer, and for $\frac{3}{4}$ first take $\frac{1}{2}$ of the given value, and then $\frac{1}{2}$ of that $\frac{1}{2}$, setting each part under the precedent, then adding them together their sum will be the Required value of the Integers and their parts. Example, what is the value of 116$\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*? To give an Answer, first I work for the value of 116 *yds.* by the 15 Rule foregoing, and then for the $\frac{1}{2}$ yard I take $\frac{1}{2}$ of 4 *s.* 6 *d.* which is 2 *s.* 3 *d.* and add to the Rest found as before, then adding them together, I find the total value of 116$\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard* to amount to 26 *l.* 04 *s.* 3 *d.* as by the work in the Margent.

yds.	*r.*	*d.*
116$\frac{1}{2}$ *at*	4	6
11 *l.* 12 *s.*		
14	10	*d.*
	2	3
26	04	3 *facit*

Other Examples follow.

$324\frac{1}{4}$ *yds. at* 4*s.* 10*d.*

1296
162
108
1--$2\frac{1}{2}$ *d.*

15617

78 *l.* 7 *s.* $2\frac{1}{2}$ *d. facit.*

$228\frac{3}{4}$ ells at 12*s.* 11*d.*

2736
76
76
57
6 $5\frac{1}{2}$ *d.*
3 $2\frac{3}{4}$ *d.*

29514 $8\frac{1}{4}$ *d.*

147 *l.* 14 *s.* $8\frac{1}{4}$ *d. fac.*

$720\frac{1}{2}$ yds. *at* 6 *s.* 8 d.

240 *l.* 3 *s.* 4 *d. facit*

C. qrs. l. *l. s.*
28 3 14 *at* 1 10 *per C.*

28 *l.*
14 *l.*
00 15 *s.*
7 *s.* 6 *d.*
3 *s.* 9 *d.*

43 *l.* 6 *s.* 3 *d. facit.*

Many more queſtions may be ſtated, and ſeveral other rules of practice may be ſhewn according to the method of divers authors but what have been delivered here are ſufficient for the practical Arithmetician in all caſes whatſoever.

CHAP.

CHAP. XXVII.

The Rule of Barter.

1. BArter is a Rule amongſt Merchants which (in the exchanging of one Commodity for another) informs them ſo to proportion their Rates as that neither may ſuſtain loſſe.

2. To reſolve queſtions in *barter*, it will not be difficult to him that is acquainted with the Golden Rule, or Rule of 3, it being altogether uſed in reſolving ſuch queſtions.

Queſt. 1. Two Merchants, *viz.* A and B *barter*, A hath 13 C. 3 qrs. 14 l. of Pepper at 2 l. 16 s. per C. and B hath Cotton at 9 d. per l. I demand how much Cotton B muſt give A for his Pepper?

Anſwer. 9 C. 1 qr.

Firſt find by the Rule of 3 how much the Pepper is worth, ſaying

If 1 C. coſt 2 l. 16 s. what will 13 C. 3 qrs. 14 l. coſt.

Anſw. 38 l. 17 s.

Secondly,

Secondly by the Rule of 3 ſay, if 9 d. buy 1 l. of Cotton how much will 38 l. 17 s. buy?

Anſwer. $9\frac{1}{4}$ and ſo much Cotton muſt B give to A for 13 C. 3 qrs. 14 l. of pepper at 2 l. 16 s. per C. when the Cotton is worth 9 d. per l.

Queſt. 2. Two Merchants (A and B) *barter*, A hath Ginger worth 1 l. 17 s. 4 d. per C. but in *barter* he will have 2 l. 16 s. per C. B. hath Nutmegs worth 5 l. 12 s. per C. now I demand how B muſt rate his Nutmegs per C. to make his gain in *barter* equal to that of A?

Anſwer, 8 l. 8 s.

Say by the Rule of 3 if 1 l. 17 s. 4 d. require 2 l. 16 s. in *barter* what will 5 l. 12 s. require in *barter*?

Facit 8 l. 8 s.

Queſt. 3. A and B *barter*, A hath 120 yds of Broadcloath worth 6 s. per yd. but in *barter* he will have 8 s. per yd. B hath ſhalloon worth 4 s. per yd. Now I demand how many yds. of ſhalloon B muſt give A for his broad-cloth making his gain in *barter* equal to that of A?

Anſwer, 180 yds. of ſhalloon.

Firſt (as in the laſt queſtion) find out how B. ought to ſell his ſhalloon in *barter*, *viz.* ſay If 6 s. require 8 s. what will 4 s. require?

Anſw.

Answer. 5 s. 4 d.

Thus you see that B must sell his shalloon in *barter* at 5 s. 4 d. if A sell his broadcloth at 8 s. per yd.

It remaineth now to find how much shalloon B must give for 120 yds. of broadcloth, which after the same method used to resolve the first question of this Chap. is found to be 180, and so many yds of shalloon must B give A for the 120 yds. of broad-cloath.

Quest. 4. A and B *bartered* A had 14 C. of Sugar worth 6 d. per l. for which B gave him 1 C. 3 qrs. of Cinnamon, I demand how B rated his Cinnamon per l. ?

Answer 4 s. per pound.

Quest. 5. A and B *barter*, A hath 4 Tun of Brandy worth, 37 l. 16 s. ready mony, but in *barter* he hath 50 l. 8 s. per tun, and A giveth B 21 C. 2 qrs. 11½ l. of Ginger for his 4 tun of Brandy, I desire to know how B sold his Ginger in *barter* per C. and how much it was worth in ready mony?

Answer. For 9 l. 6 s. 8 d. in *barter*, and it was worth 7 l. per C. ready mony.

Quest. 6. A and B barter A hath 320 dozen of Candles at 4 s. 6 d. per dozen, for which B giveth him 30 l. in money, and the rest in Cotton at 8 d. per I. I demand how

how much Cotton he must give him more then the 30 l.?

Answ. 11 C. 1 qr.

Quest. 7. A and B barter, A hath 608 yds. of broadcloth worth 14 s. *per yd.* for which A giveth him 125 *l.* 12 *s.* ready mony and 85 C, 2 qrs. 24 l. of Bees-wax, now I desire to know how he reckoned his Wax per C.?

Answer. 4 l. 13 s. 4 d. per C.

CHAP. XXVIII.

Questions in Losse and Gain.

Quest. 1. A Merchant bought 436 yds of broad-cloth for 8 s. 6 d. per yd. and selleth it again at 10 s. 4 d. per yrd. now I desire to know how much he gained in the sale of the 436 yds?

Answ. 39 l. 19 s. 4 d.

First find out by the Rule of Three or Practice

Practice how much the Cloth coſt him at 8 s. 6 d. *per* yd. *viz.* 185 *l.* 6 *s.* then by the ſame Rule find out how much he ſold it for *viz.* 225 *l.* 5 *s.* 4 *d.* then ſubtract 185 *l.* 6 *s.* which it coſt him, from 225 *l.* 5 *s.* 4 *d.* which he ſold it for, and there remaineth 39 *l.* 19 *s.* 4 *d.* for his gain in the ſale thereof.

Otherwiſe it may ſooner be reſolved thus, firſt find out how much he gained *per yd. viz.* ſubtract 8 *s.* 6 *d.* which he gave *per yd.* from 10 *s.* 4 *d.* which he ſold it for *per yd.* the remainder is 1 *s.* 10 *d.* for his gaines *per yd.* then ſay.

If 1 yd gain 1 *s.* 10 *d.* what will 436 yds. gain? *Anſwer.* by the Rule of three is 39 *l.* 19 *s.* 4 *d.* as was found before.

Queſt. 2. A Draper bought 124 yds. of Holland cloth, for which he gave 31 *l.* I deſire to know how he muſt ſell it *per yd.* to gain 10 *l.* 6 *s.* 8 *d.* in the whole ſale of the 124 *yds?* anſw. at 6 *s.* 8 *d. per yd.*

Add the price which it coſt him, (*viz.* 31 *l.*) to his intended gain (*viz.* 10 *l.* 6 *s.* 8 *d.*) the ſum is 41 *l.* 6 *s.* 8 *d.* then ſay.

If 124 *yds* require 41 *l.* 6 *s.* 8 *d.* what will 1 *yd.* require? by the Rule of Three I find the anſwer 6 *s.* 8 *d.*

Queſt. 3. A Grocer bought 3 *C.* 1 *qrs.* 14 *l.* of Cloves which coſt him 2 *s.* 4 *d. per l.* and ſold them for 52 l. 14 s. I deſire to know

know how much he gain'd in the whole? answer 8 *l.* 12 *s.*

Queſt. 4. A *Draper* bought 86 Kerſies for 129 *l.* I demand how he muſt ſell them per piece to gain 15 *l.* in laying out 100 *l.* at that rate? answer 1 *l.* 14 *s.* 6 *d. per* piece, for

As 100 *l.* is to 115 *l.* ſo is 129 *l.* to 148 *l.* 7 *s.*

So that by the proportion above, I have found how much he muſt receive for the 86 Kerſies to gain after the rate of 15 *l. per C.* then to find how he muſt ſell them *per* piece I ſay.

As 86 pieces is to 148 *l.* 7 *s.* ſo is 1 piece to 1 *l.* 14 *s.* 6 *d.* which is the number ſought.

Queſt. 5. A *Grocer* bought 4¼ *C.* of pepper for 15 *l.* 14 *s.* 7 *d.* and (it proving to be damnified) is willing to loſe 12 *l.* 10 *s. per C.* I demand how he muſt ſell it *per l.*? answer 7 *d. per l.*

Subtract 12 *l.* 10 *s.* the loſſe of 100 *l.* from *l.* and there remains 87 *l.* 10 *s.* then ſay

As 100 *l.* is to 87 *l.* 10 *s.* ſo is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* ſo much as he muſt ſell it all for to loſe after the rate propounded, then to know how he muſt ſell it *per l.* I ſay.

As 13 *l.* 17 *s.* 6 *d.* is to 4¼ *C.* ſo is 1 *l.* to 7 *d.*

Queſt.

Queſt. 6. A *Plummer* ſold 10 fodder of Lead (the *fodder* containing $19\frac{1}{2}$ C.) for 204 *l.* 15 *s.* and gained after the rate of 12 *l.* 10 *s.* *per* 100 *l.* I demand how much it coſt him *per C.*? anſwer 18 *s.* 8 *d.*

To reſolve this queſtion add 12 *l.* 10 *s.* (the gain *per C.*) to 100 *l.* and it makes 112 *l.* 10 *s.* then ſay.

As 112 *l.* 10 *s.* is to 100 *l.* ſo is 204 *l.* 15 *s.* to 182 *l.*

Which 182 *l.* is the ſum it coſt him in all then reduce your 10 *fodders* to half hundreds and it makes 390, then ſay

As 390 half hundreds is to 182 *l.* ſo is 2 half hundreds to 18 *s.* 8 *d.* the price of 2 half hundreds or one C. weight and ſo much it ſtood him in *per C.*

Queſt. 7. A Merchant bought 8 tuns of Wine, which being ſophiſticated he ſelleth for 400 *l.* and loſeth after the rate of 12 *l.* in receiving 100 *l.* now I demand how much it coſt him *per tun*? and how he muſt ſell it *per gall.* to loſe after the ſaid rate? anſwer it coſt 56 *l.* *per tun*, and he muſt ſell it at 3 *s.* 11 *d.* $2\frac{9}{21}$ qrs. *per gallon* to loſe 12 *l.* in receiving 100 *l.*

To reſolve this queſtion I conſider in the firſt place, that in receiving 100 *l.* he loſeth 12 *l.* therefore 100 comes in, for 112 *l.* laid out, wherefore to find how much he laid out for the whole I ſay

As

As 100 *l.* is to 112 so is 400 *l.* to 448 *l.* and so much the 8 tun cost him, then to find how much it cost *per tun*, I say

As 8 is to 448 *l.* so is 1 to 56 *l.* the price it cost *per tun.*

Now to find how he must sell it *per gall.* reduce the 8 *tuns* into gallons they make 2016, then say

As 2016 gall. is to 400 *l.* so is one gall. to 3 *s.* 11 *d.* $2\frac{10}{21}$ *qrs.* the price he must sell it *per gallon* to lose as aforesaid.

Quest. 8. A *Merchant* bought 8 *tuns* of Wine, which being sophisticated he is willing to sell for 400 *l.* and loseth 12 *l.* in laying out 100 *l.* upon the same, now I demand how much it cost him *per tun* ?

Here I consider that for 100 *l.* laid out he receiveth but 88 *l.* therefore to find what the 8 tuns cost him I say

As 88 *l.* to 100 *l.* so is 400 *l.* to $454\frac{6}{11}$ the price it all cost him, then to find how much *per tun* I say

As 8 is to $454\frac{6}{11}$ *l.* so is one to $56\frac{9}{11}$ or 56 *l.* 16 *s.* 4 *d.* $1\frac{5}{11}$ *qrs. per tun.*

CHAP

CHAP. XXIX.

Equation of Payments.

1. EQuation of payments, is that Rule amongſt Merchants whereby to reduce the times for payment of ſeveral ſums of money to an equated time for the payment of the whole debt without dammage to Debtor or Creditor, and

The Rule is

2. Multiply the ſums of each particular payment by its reſpective time, then add the ſeveral products together and their ſum divide by the total debt, and the quotient hence ariſing is the equated time for the payment of the wole debt. Example.

Queſt. 1. A is indebted to B in the ſum of 130 *l.* whereof 50 *l.* is to be paid at 2 months, and 50 *l.* at 4 months, and the reſt at 6 months, now they agree to make one payment of the total ſum, the queſtion is what is the equated time for payment without dammage to debtor or creditor?

To reſolve this queſtion I multiply each payment by its time, *viz.*

50 *l. multiplyed by 2 months produceth*	100
50 *l. multiplyed by 4 moneths produceth*	200
30 *l. multiplyed by 6 months produceth*	180
The ſum of the products is	480

Then I divide 480 (the ſum of the products) by 130 (the total debt) and the quotient is $3\frac{9}{13}$ months for the time of paying the whole debt.

Queſt. 2. A *Merchant* hath owing him 1000 *l.* to be paid as followeth, *viz.* 600 *l.* at 4 months, 200 *l.* at 6 months. and the the reſt which is 200 *l.* at 12 months; and he agreeth with his debtor to make one payment of the whole, I demand the time of payment without dammage to debtor or Creditor;

600 *l. multiplyed by 4 months is*	2400
200 *l. multiplyed by 6 months is*	1200
200 *l. multiplyed by 12 months is*	2400
The ſum of the products is	6000

and

and the sum of the products (6000) divided by the whole debt 1000 *l.* quotes 6 mon. for the time of payment of the whole debt.

3. The truth of this Rule is thus manifest, if the interest of that money which is paid (by the equated time) after it is due, be equal to the interest of that money which (by the equated time) is paid so much sooner then it is due at any rate *per C.* then the operation is true, otherwise not. example. In the last question 600 *l.* should have been paid at 4 months but it is not discharged till 6 months (that is 2 months after it is due) wherefore its interest for 2 months at 6 *per C. per annum* is 6 *l.* and then 200 *l.* was to be paid at 6 months which is the equated time for its payment, therefore no interest is reckoned for it, but 200 *l.* should have been paid at 12 mon. but it is to be paid at 6 months which is 6 months sooner then it ought, wherefore the interest of 200 l. for 6 months is 6 *l.* (accompting 6 *l. per Cent. per annum*) which is equal to the interest of 600 *l.* for 2 months wherefore the work is right.

The proof of the Rule of Equation of Payments.

Quest. 3. *A Merchant* hath owing him a certain sum to be discharged at 3 equal payments *viz.* $\frac{1}{3}$ at two months $\frac{1}{3}$ at four

four mon. and $\frac{1}{4}$ at 8 mon. the queſtion is what is the equated time for the payment of the whole debt?

In queſtions of this nature (*viz.* where the debt is divided into equal or unequal parts) each of the parts is to be multiplyed by its time, and the ſum of the products is the anſwer

$\frac{1}{3}$ *multiplyed by* 2 *mon. produceth* $\frac{2}{3}$
$\frac{1}{3}$ *multiplyed by* 4 *moneths produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *multiplyed by* 8 *months produceth* $2\frac{2}{3}$

The ſum of the products is $4\frac{2}{3}$ which is $4\frac{2}{3}$ months for the equated time of payment.

If inſtead of the *fractions* (repreſenting the parts) you had wrought by the numbers themſelves (repreſented by thoſe parts) according to the firſt and ſecond, examples, it would have been the ſame anſwer, as ſuppoſe the debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each payment, *viz.* at 2, 4 and 8 months, then

30 *l. multiplyed by* 2 *mon. produceth* 60
30 *l. multiplyed by* 4 *mon. produceth* 120
30 *l. multiplyed by* 8 *mon. produceth* 240

The ſum of the products is 420 which divided by 90 (the whole debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{3}$ months as before.

Queſt. 4

Queſt. 4. A Merchant oweth a Sum of money, to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Moneths, and $\frac{1}{4}$ at 10 Moneths, and he agreeth with his Creditor to make one total payment; I demand the time, without damage to Debtor or Creditor? Work as in the laſt Queſtion, and you will find the Anſwer to be 7 Moneths.

Queſt. 5. *A* is indebted to *B* 640*l.* whereof he is to pay 40*l.* preſent money, and 350*l.* at 3 Moneths, and the reſt (*viz.* 250*l.*) at 8 Moneths, and they agree to make an Equated time for the whole Payment, now I demand the time?

In Queſtions of this Nature (*viz.* where there is ready money paid) you are (in Multiplying) to neglect the money that is to be paid preſent, and work with the reſt as is before directed, and Divide the ſum of the Products by the whole Debt, and the Quote is the Anſwer: for here 40*l.* is to be paid preſent, and hath no time allowed, and according to the Rule it ſhould be Multiplied by its time, which is (0) therefore 40 times 0 is 0, which neither augmenteth nor diminiſheth the Dividend; wherefore (to proceed according to direction) I ſay,

350 *by* 3 *Moneths, produceth*	1050
250 *by* 8 *Moneths, produceth*	2000
The Sum of the Products is	3050

which Divided by 640, the whole Debt, the Quote is $4\frac{49}{64}$ Moneths, the time of payment.

Queſt 6. *A* is indebted to *B* in a certain Sum, $\frac{1}{2}$ whereof is to be paid preſent money, $\frac{1}{3}$ at 6 Moneths, and the reſt at 8 Moneths; now I demand the Equated time for the payment of it all?

Anſwer. $3\frac{1}{3}$ moneths is the time of payment.

Queſt. 7. *A* is indebted to *B* 120 *l.* whereof $\frac{1}{3}$ is to be paid at 3 moneths, $\frac{1}{4}$ at 6 moneths, and the reſt at 9 moneths; what is the Equated time for the payment of the whole Sum?

Anſwer. At $6\frac{1}{4}$ moneths.

Queſt. 8. *A* is indebted to *B* 420 *l.* which is due at the end of 6 moneths; but *A* is willing to pay him 140 *l.* preſent, provided he can have the remainder forborn ſo much the longer to make Satisfaction for his kindneſs, which is agreed upon, I deſire to know what time ought to be alotted for the payment of the 280 *l.* remaining?

To reſolve this Queſtion, firſt, find out what is the Intereſt of 140 *l.* for the time it wa

was paid before it was due, at 6 *per Cent.* (or any other rate) (*viz.* 6 moneths) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* muſt be detained ſo much longer than 6 moneths, as the while it may eat out that Intereſt, *viz.* 4 *l.* 4 *s.* which is thus found out, *viz.* Firſt, ſee what is the Intereſt of 280 *l.* for a moneth, or any other time; but here we will take one moneth, and its Intereſt for one moneth is 28 *s.*

Then by the Rule of Three ſay,

As 28 *s.* is to 1 moneth, ſo is 84 *s.* to 3 moneths; ſo that the 280 *l.* remaining muſt be kept 3 moneths beyond its firſt time of payment, (*viz.* 6 moneths) which added thereto, makes 9 moneths, at the end of which time *A* ought to make payment of the remainder.

CHAP. XXX.

Exchange.

1. THE Rule of Exchange informeth Merchants how to Exchange Moneys, Weights, or Measures of one Countrey into (or for) the Moneys, Weights, or Measures of another Countrey, and when the Rate, Reason, or Proportion betwixt the Money, Weights, or Measures of different Countreys is known, it will not be difficult for the Practitioner that is well acquainted with the Rule of Proportion (or Rule of Three) to solve any Question wherein it is required to Exchange a given quantity of the one kind, into the same value of another kind.

2. In Questions of Exchange, there is always a Comparison made between the Coyns, *&c.* of two Countreys (or kinds) or of more.

3. In Questions where there is a Comparison made between two things (whether they be Moneys, Weights, *&c.*) of different

different kinds (or Countries) there may be a ſolution found by a ſingle Rule of 3, as may appear by the following Example.

Queſt. 1. A Merchant at *London* delivered 370*l. Sterling*, to receive the ſame at *Paris* in *French* Crowns, the exchange $3\frac{1}{3}$ *French* Crowns *per* pound *Sterling*. I demand how many *French* Crowns ought he to receive?

In placing the Numbers obſerve the 6 Rule of the 10 Chapter, which being done, ths given Numbers will ſtand thus,

l.	*Crowns.*	*l.*
1	$3\frac{1}{3}$	370

and being Reduced according to the Rules of the 24 Chapter, will ſtand thus,

l.	Crowns.	*l.*	Crowns.
As $\frac{1}{1}$ is to	$\frac{10}{3}$	ſo is $\frac{370}{1}$ to	$1233\frac{1}{3}$

So that I conclude he ought to Receive $1233\frac{1}{3}$ *French* Crowns at *Paris* for his 370*l.* delivered at *London*.

Queſt. 2. A Merchant delivered at *Amſterdam* 587*l. Flemiſh*, to receive the value thereof at *Naples* in Ducats, the exchange $4\frac{4}{5}$ Ducats *per l. Flemiſh*: I demand how many Ducats he ought to receive?

The Proportion is as followeth.

l.	Ducats.	*l.*	Ducats.
As $\frac{1}{1}$ is to	$\frac{24}{5}$	ſo is $\frac{587}{1}$ to	$2817\frac{3}{5}$

So I find he ought to receive $2817\frac{3}{5}$ Ducats

cats at *Naples* for the 587 *l. Flemiſh* delivered at *Amſterdam.*

Queſt. 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the value at *London* in pence, the exchange 53½ pence *Sterling per* Ducatoon; I demand how much *Sterling* he ought to receive?

The Proportion for Reſolution is,

As Ducats. 1/1 is to d. 10 7/2 ſo is Ducats. 3478 8/1 to 186073 which is equal to 775 *l.* 6 1/2 for the Anſwer.

I might here (according to the Cuſtom of Arithmetical Writers) lay down Tables for the Reduction of Foreign Coyns to *Engliſh*; but by Reaſon of their Inſtability (for they continue not at a conſtant ſtandard, as our *Sterling* money doth, but are ſometimes raiſed, and ſometimes depreſſed) I ſhall forbear.

4. When there is a Compariſon made between more than two different Coyns, Weights, or Meaſures, there ariſeth ordinarily two different caſes from ſuch a Compariſon.

1. When it is Required to know how many Pieces of the firſt Coyn, Weight, or Meaſure are equal in value to a known number of Pieces of the laſt Coyn, Weight, or Meaſure.

2. When

2. When it is Required to find out how many Pieces of the laſt Coyn, Weight, or Meaſure are equal in value to a given number of the firſt ſort of Coyn, Weight, or Meaſure.

An Example of the firſt Caſe may be this, VIZ.

Queſt. 4. If 150 pence at *London* are equal to 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*, then how many pence at *London* are equal to 138 ſhillings at *Bruſſels*? *Facit* 960 *d.*

This Queſtion may be Reſolved at two ſingle Rules of Three; for firſt I ſay,

If $\frac{3}{1}$ Ducats at *Naples* make 150 pence at *London*, how many pence will $4\frac{4}{5}$ Ducats make?

Anſw. 240 pence.

By the fore-going Proportion we have diſcovered, that $4\frac{4}{5}$ Ducats at *Naples* make 240 pence at *London*: And by the Tenour of the Queſtion we ſee that $4\frac{4}{5}$ Ducats at *Venice* make $34\frac{1}{2}$ ſhillings at *Bruſſels*, therefore 240 pence at *London* are equal to $34\frac{1}{2}$ ſhillings at *Bruſſels*, (for the things that are equal to one and the ſame thing, are alſo equal to one another,) wherefore we have

a way laid open to give a ſolution to this Queſtion by another Single Rule of Three, whoſe Proportion is,

As $34\frac{1}{2}$ ſhillings at *Bruſſels* is to 240 pence at *London*; ſo is 138 ſhillings at *Bruſſels* to 960 pence at *London*, which is the Anſwer to the Queſtion.

An Example of the Second Caſe may be this, VIZ.

Queſt. 5. If 40 *l.* *Averdupoize* weight at *London* is equal to 36 *l.* weight at *Amſterdam*; and 90 *l.* at *Amſterdam* makes 116 *l.* at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* of *Averdupois* weight at *London*?

Anſwer. $129\frac{2}{5}\frac{3}{5}$ pounds at *Dantzick.*

This Queſtion is likewiſe anſwered at two ſingle Rules of Three, *viz.* Firſt, I ſay,

As 36 *l.* at *Amſterdam* is to 40 *l.* at *Lond.*
So is 90 *l.* at *Amſterdam* to 100 *l.* at *Lond.*

And by the Queſtion you find that 90 *l.* at *Amſterdam* is 116 *l.* at *Dantzick*; and therefore 100 l. at *London* is likewiſe equal thereunto; wherefore again I ſay,

As 100 l. at *London* is to 116 l. at *Dant.*
So is 112 l. at *London* to $129\frac{2}{5}\frac{3}{5}$ at *Dant.*

By

By which I find that 112 $\frac{2}{3}\frac{3}{5}$ l. at *Dantzick* are equal to 112 l. *Averdupois* weight at *London.*

5. There is a more ſpeedy way to Reſolve ſuch Queſtions as are contained under the two Caſes before mentioned, laid down by Mr. *Kerſey* in the third Chapter of his Appendix to Mr. *Wingates* Arithmetick, where he hath given two Rules for the Reſolution of the Queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the ſolution of both Caſes; and firſt, let the Learner obſerve the following Directions in placing of the given terms, *viz.*

7. Let there be made two Collumes, and in theſe Collumes ſo place the given terms one over the other, as that in the ſame Collume there may not be found two Terms of the ſame kind one with the other.

Having thus placed the Terms, the General Rule is,

Obſerve which of the ſaid Collumes hath the moſt Terms placed in it, and multiply all the Terms therein continually, and place the laſt Product for a Dividend; then multiply the Terms in the other Collume continually, and let the laſt Product be a Diviſor; then divide the ſaid Dividend by the ſaid Diviſor, and the Quotient thence

ariſing is the anſwer to the queſtion.

So the example of the firſt of the ſaid caſes being again repeated, *viz.* If 150 pence at *London* make 3 ducats at *Naples*, and $4\frac{4}{5}$ ducats at *Naples* make $34\frac{1}{2}$ ſhill. at *Bruſſels*, then how many pence at *London* are equal to 138 ſhillings at *Bruſſels*?

The terms being placed according to the 7 Rule will ſtand as followeth.

	A	B	
Pence at Lond.	150	3	*Duc. at Na.*
Ducats at Na.	$4\frac{4}{5}$	$34\frac{1}{2}$	*ſhill. at Bruſſ.*
Shil. at Bruſſ.	138		

having thus placed the terms, that in neither collume there is 2 terms of one kind, then I obſerve that the collume under A hath moſt terms in it, therefore they muſt be multiplyed together for a dividend; *viz.* 150 mult. by $4\frac{4}{5}$ produceth $\frac{3600}{5}$ which multiplyed by 138 produc. $\frac{496800}{5}$ for a dividend, then in the collume under B there are 3 and $34\frac{1}{2}$ which multiplyed together produceth $\frac{207}{2}$ for a diviſor; then having divided $\frac{496800}{5}$ by $\frac{207}{2}$ the quotient is 960 pence for the anſwer as before.

Again, let the example of the ſecond caſe be again repeated, *viz.* If 40 *l.* Averdupois weight at *London* make 36 l weight at

at *Amſterdam*, and 90 *l.* at *Amſterdam* make 116 *l.* at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London*.

The terms being diſpoſed according to the 7 Rule foregoing will ſtand thus

	A	B	
l. at *Lond.*	40	36	*l.* at *Amſterdam.*
l. at *Amſt.*	90	116	*l.* at *Dantzick.*
		112	*l.* at *London.*

whereby I find that the terms under B multiplyed together produce 467712 for a dividend, and the terms under A *viz.* 40 and 90 produce 3600 for a diviſor and diviſion being finiſhed the quotient giveth $129\frac{33}{36}\frac{12}{36}$ pounds at *Dantzick* for the anſwer.

Chap.

CHAP. XXXI.

Single Position.

1. NEgative Arithmetick called the Rule of False, is that by which we find out a truth, by numbers invented or supposed, and this is either single or double.

2. The Rule of Single Position is when at once, *viz.* by one False position, or feigned number, we find out the true number sought.

3. In the single Rule of False, when you have made choice of your position, work it according to the tenour of the question, as if it were the true number sought, and if by the ordering of your position you find the result either too much or too little you may then find out the number sought, by this proportion following *viz.*

As the result of your position, is to the position, so is the given number to the number sought.

Exam-

Example.

Queſt. 1. A Perſon having about him a certain number of Crowns, ſaid if the fourth and third and ſixth of them were added together they would make juſt 45, now I demand the number of Crowns he had about him? *Anſwer* 60 Crowns.

To reſolve this queſtion I ſuppoſe he had 24 Crowns (or any other number that will admit of the like diviſion) now the fourth of 24 is 6, and the third is 8, and the ſixth is four, all which parts (*viz.* 6, 8, and 4,) being added together make but 18, but it ſhould be 45, wherefore I ſay by the Rule of three.

As 18 the ſum of the parts, is to the poſition 24 ſo is 45 the given number to 60 the true number ſought.

For the fourth of 60 is 15, and the third of 60 is 20, and the ſixth of 60 is 10, which added together make 45.

Queſt. 2. Three Perſons, *viz.* A, B, C, thus diſcourſe together concerning their age, quoth B to A I am as old, and half as old again as you, then quoth C to B I am twice as old as you, then quoth A to them, and I am ſure the ſum of all our ages is 165, now I demand each mans age? *Anſwer A* 30, *B* 45, *C* 90, years of age, which added together makes 165.

CHAP.

CHAP. XXXII.

Double Position.

1. THe Rule of Double Position is, when 2 False positions are assumed, to give a resolution to the question propounded.

2. When any question is stated in double position, make such a crosse as followeth.

3. Then make choice of any number you think may be convenient for your working, which call your first position, and place it at that end of the crosse at *a*, then work with this position (as if it were the true number sought,) according to the nature of your question, then having found out your errour, either too much or

too

too little place, it on that ſide the croſſe *d*, then make choice of another number of the ſame denomination with the firſt poſition (which call your ſecond *poſition*) and place it on that ſide of the croſſe at *b*, then work with this *poſition* as with the former, and having found out your error, either too much or too little, place it on that ſide of the croſſe at *c*, and then the poſitions will ſtand at the top of the croſſe, and the errors at the bottom each under his correſpondent *poſition*, and then multiply the errors into the *poſitions* croſs-wiſe, that is to ſay multiply the firſt *poſition* by the ſecond error, and the ſecond *poſition* by the firſt error, and put each product over its *poſition*.

4. Having proceeded ſo far, then conſider whether the errors were both alike, that is, whether they were both too much, or both too little, and if they are alike, then ſubtract the leſſer product from the greater and ſet the remainder for a dividend, then ſubtract the leſſer error from the greater, and let the remainder be a diviſor, then the quotient ariſing by this diviſion is the anſwer to the queſtion.

5. But if the errors are unlike, that is one too much and the other too little, then add the products of the *poſitions* and errors, together and their ſum ſhall be a dividend, then

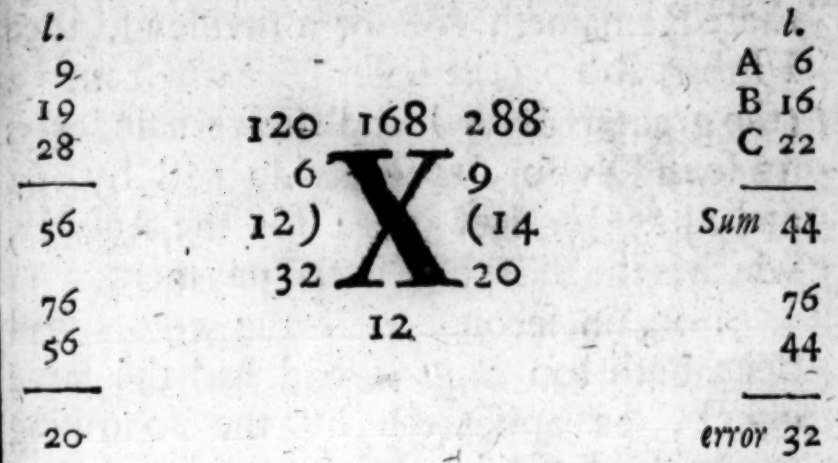
then add the *errors* together and their sum shall be a Divisor; and the quotient arising hence is the Answer; which two last Rules may be kept in memory by this verse following; *viz.*

When Errors are of unlike kinds
Addition *doth ensue.*
But if alike, Subtraction *finds*
Dividing work for you.

Quest. 1. A, B and C Build a house which cost 76 *l.* of which A paid a certain sum unknown, B paid as much as A and 10 *l.* over, and C paid as much as A and B, now I desire to know each mans share in that Charge?

Having made a Cross according to the 2. Rule, I come according to the third Rule to make choice of my first position, and here I suppose A paid 6 *l.* which I put upon the Cross as you see; then B paid 16 *l.* (for it is said he paid 10 *l.* more then A) and C paid 22 *l.* for 'tis said he paid as much as A and B, then I add their parts

120



and they amount to 44, but it is said they paid 72 *l.* wherefore it is 32 too little, which I note down at the bottom of the Cross under its position for the first error.

Secondly, I suppose A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together make 56, but they should make 76, wherefore the error of this position is 20 which I put at the bottom of the Cross under his position, for the second *Error*, then I multiply the *Errors* and the *Positions* Cross-wise, *viz.* 32 (the *Error* of the first *Position*) by 9 (the second position) and the product is 288. Then I multiply 20 (the *Error* of the second *Position*) by 6 (the first *Position*) and the Product is 120.

Then (according to the 4th. Rule) I subtract the lesser product from the greater, (*viz.* 120 from 288 because the *Errors*

rors are both alike, *viz.* too little) and there Remaineth 168 for a dividend, then I ſubtract 20 (the leſſer *Error*) from 32 (the greater *Error*) and the remainder is 12 for a Diviſor, then divide 168 by 12 and the Quotient is 14 for the Anſwer, which is the ſhare of A in the payment.

6. Again ſecondly, If the errors had been both too bigg it had had the ſame effect, as appeareth by the following work; for firſt I ſuppoſe A payed 20 *l.* then B paid 30 *l.* and C 50 *l.* which in all is 100 but it ſhould have been no more then 76, wherefore the firſt *Error* is 24 too much. Again I ſuppoſe A paid 18 *l.* then B muſt pay 28 *l.* and C muſt pay 46 *l.* which in all

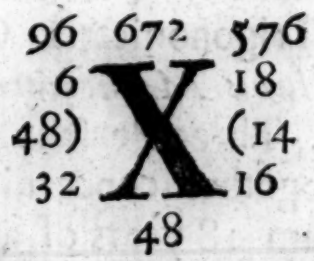
20 A	320	112	432	A 18
30 B	20	X	18	B 28
50 C	8)		(14 *facit*	C 46
100 *ſum*	24		16	*ſum* 92
76 *ſubtr.*		8		*ſubtr* 76
24 *error*				*error* 16

is 92 *l.* but it ſhould have been but 76 *l.* wherfore the ſecond *Error* is 16 too much; then I Multiply 20 (the firſt *Poſition*) by 16 (the ſecond *Error*, and the product is 320, again I multiply 18 (the ſecond *Poſition*) by

by 24 (the firſt *Error*) and the product is 432.

Then becauſe the *Errors* are both too much I ſubtract 320 (the leſſer product) from 432 (the greater product) and there Remaineth 112 for a Dividend, likewiſe I ſubtract 16 (the leſſer *Error*) from 24 (the greater *Error*) and the difference is 8 for a Diviſor, then perform Diviſion, and the Quotient is 14 (as before) for the anſwer.

Again Thirdly, If the *Errors* had been the one too bigg, and the other too little, Reſpect being had to the 5th. Rule foregoing, the anſwer would have been the ſame; as thus, I take for my firſt *Poſition* 6, and then the *error* is 32 too little, then I take for my ſecond *Poſition* 18, and then the *error* is 16 too much, then I multiply the Poſitions and *errors* Croſs-wiſe, and the products are 96 and 576, and becauſe the *errors* are unlike



viz. one too bigg, and another too little, I add

add the products 96 and 576 together, and their sum is 672 for a Dividend, I likewise add the *errors* 32 and 16 together, and their sum is 48 for a Divisor, then having finished Division I find the quotient to be 14 which is the answer, as was found out at the 2 several Tryals before.

For Proof of the work I say

	l.
If A *paid*	14
Then B *paid* 14 *and* 10 (*that is*)	24
And C *paid* 14 *and* 24 (*that is*)	38
The Sum of all is	76

which is the total value of the building and equal to the given Number.

Those who desire to see the demonstration of this Rule, let them Read the 7th. Chapter of Mr. *Kersyes* Appendix to *Wingates* Arithmetick, *Petiscus* in the 5th. Book of his Trigonometria. Or Mr. *Oughtred* in his *Clavis Mathematicæ.*

Quest. 2. Three Persons, A, B, C, thus discoursed together concerning their age; Quoth A I am 18 years of age, quoth B I am as old as A and $\frac{1}{2}$ C; and quoth C, I am as old as you both, if your years were added

ded together, Now I desire to know the age of each Person? Answer A is 18, B is 54, and C is 72, years of age.

Quest. 3. A Father lying at the point of Death, left to his 3 Sons, *viz.* A, B, C, all his Estate in Money, and Divided it as followeth, *viz.* to A he gave $\frac{1}{2}$ wanting 44 *l.* to B he gave $\frac{1}{3}$ and 14 *l.* over, and to C he gave $\frac{1}{6}$ and 30 *l.* over, now I demand what was the sum left, and each mans part? Answer, the sum bequeathed was 588 *l.* whereof A had 250 *l.* B had 210 *l.* and C had 128 *l.*

Quest. 4. Two Persons *viz.* A and B had each in their hands a certain Number of Crowns, and A said to B, If you give me 1 of your Crowns I shall have 5 times as many as you, and said B to him again, If you give me one of yours then we shall each of us have an equal Number; now I demand how many Crowns had each Person? Answer, *A* had 4 and B had 2 Crowns.

Quest. 5. What Number is that unto which if I add $\frac{1}{4}$ of it self, and from the sum subtract $\frac{1}{8}$ of it self the Remainder will be 210? *Answer* 192.

Many more questions may be added but these well understood will be sufficient (even for the meanest Capacity) for the Re-

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